64TH CONGRESS, 1st Session. | HOUSE OF REPRESENTATIVES. | DOCUMENT No. 416.

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LEAF AND PASCAGOULA RIVERS, MISS.

LETTER

FROM

THE SECRETARY OF WAR,

TRANSMITTING,

WITH A LETTER FROM THE CHIEF OF ENGINEERS, REPORTS ON PRELIMINARY EXAMINATION AND SURVEY OF LEAF AND PASCAGOULA RIVERS, FROM THE MOUTH OF BOWIE CREEK TO THE JUNCTION OF PASCAGOULA AND DOG RIVERS.

DECEMBER 16, 1915.—Referred to the Committee on Rivers and Harbors and ordered to be printed, with illustration.

WAR DEPARTMENT,
Washington, December 15, 1915.

The SPEAKER OF THE HOUSE OF REPRESENTATIVES.

SIR: I have the honor to transmit herewith a letter from the Chief of Engineers, United States Army, dated May 24, 1915, together with copies of reports from Maj. (now Lieut. Col.) Henry Jervey and Maj. (now Lieut. Col.) C. A. F. Flagler, Corps of Engineers, dated October 11, 1909, and September 30, 1911, with map, on preliminary examination and survey, respectively, of Leaf and Pascagoula Rivers, Miss., made in compliance with the provisions of the river and harbor act approved March 3, 1909; also copy of supplemental report by Lieut. Col. Charles Keller, Corps of Engineers, dated February 1, 1915.

Very respectfully,

LINDLEY M. GARRISON,
Secretary of War.

WAR DEPARTMENT,
OFFICE OF THE CHIEF OF ENGINEERS,
Washington, May 24, 1915.

From: The Chief of Engineers, United States Army.
To: The Secretary of War.
Subject: Preliminary examination and survey of Leaf and Pascagoula Rivers, Miss.

1. There are submitted herewith, for transmission to Congress, reports dated October 11, 1909, by Maj. (now Lieut. Col.) Henry

Jervey, Corps of Engineers, and September 30, 1911, with map, by Maj. (now Lieut. Col.) C. A. F. Flagler, Corps of Engineers, on preliminary examination and survey, respectively, of Leaf and Pascagoula Rivers, from the mouth of Bowie Creek to the junction of Pascagoula and Dog Rivers, called for by the river and harbor act approved March 3, 1909, together with supplemental report by Lieut. Col. Charles Keller, Corps of Engineers, dated February 1, 1915.

2. The Pascagoula River is formed by the junction of Leaf and Chickasahay Rivers, and flows in a southerly direction about 82 miles where it is joined by the Dog River. The existing project for its improvement provides for the maintenance of the channel above the mouth of Dog River by the removal of obstructions from the stream from time to time. The original project for improvement of Leaf River, adopted in 1890, was designed to provide a channel for high-water navigation from Bowie Creek to the mouth of the river, a distance of 79 miles. This project was completed in 1897, and subsequent expenditures have been in the direction of maintaining the improvement.

3. Estimates of cost for the further improvement of these streams are submitted by the district engineer officer in his report of September 30, 1911, covering (*a*) the completion of the present project in two years; (*b*) a channel 4 feet deep and 75 feet wide; (*c*) a channel 6 feet deep and 75 feet wide. He believes the locality worthy of improvement by the United States to a limited extent, and recommends adoption of the 4-foot project (plan *b*), at an estimated cost of $110,500, and $15,000 annually for maintenance, this estimate being based on executing the work with a Government plant equipped for snagging and dredging. In the supplemental report of February 1, 1915, his successor recommends that, for the present, work be confined to a more liberal prosecution of the present project below Merrill, at an estimated cost of $15,000 annually. The division engineer is of opinion that no greater or more expensive improvement should be undertaken by the Government than that necessary to facilitate the floating of logs.

4. These reports have been referred, as required by law, to the Board of Engineers for Rivers and Harbors, and attention is invited to the board's report of November 4, 1912. In connection with its consideration of the subject, the board inspected the locality and held a public hearing at Hattiesburg, Miss., on October 6, 1912. The board believes that if an all-year-round 4-foot navigation could be obtained for the sum estimated in the district officer's report of September 30, 1911, the resulting benefits would justify the expenditure. From its study of the physical data availible, however, the board doubts the feasibility of obtaining the results expected by the district officer at the cost estimated by him. It believes that the expense involved would be out of reasonable proportion to resulting benefits, and therefore expresses the opinion that it is not advisable for the United States to undertake any additional improvement of the Leaf and Pascagoula Rivers at this time.

5. After due consideration of the above-mentioned reports, I concur in general with the views of the division engineer and the Board of Engineers for Rivers and Harbors, and therefore report that the improvement by the United States of Leaf and Pascagoula Rivers, from the mouth of Bowie Creek to the junction of Pascagoula

and Dog Rivers, is not deemed advisable at the present time, to a greater extent than is authorized under the existing project.

DAN C. KINGMAN,
Chief of Engineers, U. S. Army.

REPORT OF THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS ON SURVEY.

[Third indorsement.]

BOARD OF ENGINEERS FOR RIVERS AND HARBORS,
Washington, November 4, 1912.

To the CHIEF OF ENGINEERS, UNITED STATES ARMY:

1. This is a report of survey of Leaf and Pascagoula Rivers from the mouth of Bowie Creek to the junction of Pascagoula and Dog Rivers, called for by the act of March 3, 1909. The survey developed the following important facts:

Distance by river from Hattiesburg to mouth of Leaf River	miles..	78.86
From mouth of Leaf to mouth of Dog River	do....	82.10
Total distance from Hattiesburg to Dog River	do....	160.96
Fall in Leaf River	feet...	93.96
Fall per mile, about	do....	1.20
Fall in Pascagoula River	do....	31.07
Fall per mile, about	do....	.40
Navigable depth for 32 miles above Dog River	do....	8.00
Available low-water depth in Leaf River	do....	1.40
Number of shoals in these rivers with depths less than 4 feet		181

2. In its report on preliminary examination, the board requested estimates for the completion of the existing project by clearing the river of snags and obstructions, and for channels of suitable width and 4 feet and 6 feet in depth. Based upon the results of the survey, the district officer presents the following estimates:

(*a*) Completion of present project in two years:	
Work of improvement	$87,000
Annual maintenance	12,000
(*b*) For a 4-foot channel 75 feet wide:	
Estimate No. 1, based on dredging by contract—	
Work of improvement	248,560
Annual maintenance	25,000
Estimate No. 2, based on executing dredging with combined Government plant equipped for snagging and dredging—	
Work of improvement	110,500
Annual maintenance	15,000
(*c*) For a 6-foot channel 75 feet wide:	
Work of improvement	485,200
Annual maintenance	90,000

The district officer states that it would be practicable to secure navigable widths and depths on these rivers by canalization, but the cost of such work would be prohibitive.

3. From the data obtained by the survey, the theoretical discharge of the stream has been worked out for various sections, and based upon the figures obtained, the district officer states that it appears probable that a 4-foot depth could be maintained by regulation works, but that grave doubt exists as to whether a 6-foot depth could be maintained. At a public hearing held by the district officer, interested

parties expressed their willingness to abandon log driving and sack rafting on these streams if they were properly improved, the county authorities expressed their readiness to make suitable alterations in existing bridges, and the commercial interests of Hattiesburg pledged themselves to maintain a traffic line on the improved river and to provide public landing places at Hattiesburg and Merrill. The district officer is of opinion that these streams are worthy of improvement by the United States to the extent of the 4-foot project, estimate No. 2, $110,500 for works of improvement, including the necessary plant, and an annual maintenance charge of $15,000. He states:

> If this project or some other involving channel excavation and regulation is not adopted for these streams, I recommend that work thereon be abandoned, as the present project produces little, if any, beneficial results.

4. The division engineer was unable to agree with the views of the district officer as to the practicability of accomplishing the desired results at the estimated cost, and states that it does not appear that the commerce involved would justify the large expense necessary to do the work. For this reason he does not recommend the improvement.

5. With a view to securing additional information and a more intimate knowledge of physical and commercial conditions, the board held a public hearing in the city of Hattiesburg on October 16, 1912, and made such inspection of the upper river as was possible for a distance of about 20 miles below Hattiesburg. Much interest was displayed in the question of this improvement, and it is reasonable to believe that considerable benefit would be felt by the people of Hattiesburg if continuous navigation of a practical character were obtained. Those advocating the improvement seem firm in the belief that if a 4-foot channel were provided, there would be considerable commerce carried upon the river, and that railroad rates would be materially reduced thereby. The board entertains some doubt as to the former but believes that to some extent the latter would be true. It believes further that if an all-year-round 4-foot navigation could be obtained for the sum estimated by the district officer, the resulting benefits would justify the expenditure.

6. A careful analysis of the physical data of this stream and a study of the results obtained by open-channel improvement on other shoal streams in this country leads the board to seriously doubt the feasibility of obtaining the physical results expected by the district officer at the cost estimated by him. The board is aware of no stream with the same low-water discharge, slope, and character of bed that has been effectively improved by open-channel methods so as to provide a continuous 4-foot navigation. While the results desired might be possible of attainment by the use of extensive and costly works, the board believes that the commerce, present and prospective, to be benefited is not sufficient to justify this large but uncertain cost.

7. While the board fully appreciates the disadvantage of not having effective water transportation, it believes in this case that the cost of providing it would be far greater than the figures given above, and that the expense involved would be out of reasonable proportion to resulting benefits. It is therefore forced to the conclusion that it is

not advisable for the United States to undertake any additional improvement of the Leaf and Pascagoula Rivers at this time.

8. In compliance with law, the board reports that there are no questions of terminal facilities, water power, or other subjects which could be coordinated with the project proposed, in such manner as to render the improvement advisable in the interests of commerce and navigation.

For the board:

LANSING H. BEACH,
Lieut. Col., Corps of Engineers,
Senior Member Present.

PRELIMINARY EXAMINATION OF LEAF AND PASCAGOULA RIVERS, MISS.

UNITED STATES ENGINEER OFFICE,
Mobile, Ala., October 11, 1909.

SIR: 1. In compliance with instructions contained in department letter dated March 8, 1909, and in accordance with the provisions of river and harbor act approved March 3, 1909, I have the honor to submit the following report of a preliminary examination of Leaf and Pascagoula Rivers, from the mouth of Bowie Creek to the junction of Pascagoula and Dog Rivers. The present examination was made by Asst. Engineer J. M. Pratt, assisted by other employees of this office, between August 10 and 13, 1909, the entire distance, about 200 miles by river, being traversed by the party in the gasoline launch *Naomi*.

2. *Previous examinations and surveys.*—A preliminary examination of Leaf River from the mouth to Bowie Creek was made in 1889, under the direction of Maj. A. N. Damrell, Corps of Engineers, and report of same is printed in the Annual Report of the Chief of Engineers for 1889, page 1462.

The report of a preliminary examination of Pascagoula River is printed in the Annual Report of the Chief of Engineers for 1879, page 835.

3. *Geographical location.*—A description of the stream is given in the attached report of Asst. Engineer J. M. Pratt, to which attention is respectfully invited. Both streams are at present under improvement by the General Government. The existing project for Leaf River contemplates the maintenance of a channel for high-water navigation from Bowie Creek to the mouth of the river, a distance of 75 to 100 miles, by the removal of obstructions and overhanging trees. This project was completed in 1897, and since that year about $12,000 has been expended on maintenance.

The existing project for improvement of Pascagoula River above the mouth of Dog River provides for the maintenance of the channel by the removal of obstructions from the stream from time to time. The extent of the improvement was limited by the act of 1899 to the section above Dog River, and covers a distance of about 100 miles. The total amount expended on the existing project to June 30, 1909, was a little more than $29,000, all of which was applied to maintenance.

4. *Present condition of the streams.*—The Pascagoula River is non-tidal except in its lower reaches. On June 30, 1909, the river was

navigable at low water for boats of 5 feet draft as far up as Cedar Creek, about 55 miles, while above this point to the head of the river light-draft navigation was possible on a slight rise above low water. The lower 50 miles of the section of Pascagoula River under consideration are in good condition. About 94 sand and gravel bars were found in the river on the recent examination and 152 bars in Leaf River below Hattiesburg, Miss. On June 30, 1909, Leaf River was available for rafting on a fair rise above low water, being used to a very limited extent for any other form of navigation. The last examination showed that from the mouth of Bowie Creek, at Hattiesburg, Miss., to a point 30 miles below, Leaf River is filled with snags, logs, and gravel bars. The remainder of the river to its mouth is in fair condition. The width of Leaf River at low water varies from 100 to 350 feet, that of Pascagoula River from 150 to 500 feet.

The launch in which the examination was made is 33 feet long, 12 feet wide, with a draft of 3 feet. From such gauge readings as are available, Leaf River at Hattiesburg was 12 to 18 inches above the ordinary low-water stage, and Pascagoula River at Merrill, Miss., was 3 to 4 feet above the ordinary low water. Extreme low-water stages are shown in the accompanying report of the assistant engineer. While the launch made the trip in good time, many obstructions were encountered, indicating that steamboat navigation would be dangerous or impracticable on the upper reaches in the present condition of the streams.

Year after year snags and trees are brought into the river by high water and caving banks. Also, at high water large quantities of loose saw logs are floated out of the swamps and low lands where they have been previously cut and these drift down the river until caught at some boom or sawmill. Some of these logs sink and form obstructions in the river, many lodge against the banks and are left there when the water recedes. The trees, snags, or logs which stop in the bed of the stream cause the formation of bars; it is probable that if these obstructions were entirely cleared out each year there would be a reduction in the number of sand bars.

5. *Bridges.*—From Bowie Creek to the mouth of Leaf River there are 10 fixed bridges, with headroom above water (at the stage at which the examination was made) of from 23 to 31.5 feet. Spanning the Pascagoula River at Merrill, Miss., is a railroad bridge. This bridge has a draw span which is now being repaired, so that it will be in operation within a short time. With the exception of three bridges at Hattiesburg, the upper end of the proposed improvement, all of the above fixed bridges will have to be removed or provided with draw spans to accommodate the usual river steamboat traffic. As they now stand they limit the possible use of the river to barges or small steamers at moderate stages of the river, while at high stages nothing could pass them.

6. *Resources, industries, and commerce.*—The present commerce on Leaf River is limited to rafting logs and timber; its tonnage since 1905 has been about 200,000 tons annually, of a value estimated from $600,000 to $1,200,000. On Pascagoula River, 90 per cent of the tonnage is in logs, lumber, and piling seeking the sawmills or shipping at Moss Point; its amount is now 300,000 tons annually, with a value of $1,800,000. This represents an increase of about 30 per cent since 1905. The forests along these rivers still contain large quantities of

fine timbers, both pine and hardwood. As the forests are cut, no doubt the land will be cleared and put into cultivation by an increase of population. At present, however, the country is sparsely settled and the development may be a matter of many years. The town of Hattiesburg, situated on Leaf River at the mouth of Bowie Creek, has a population of 15,000. The chief industries are sawmills, a cotton compress, and a fertilizer factory. A number of railroads enter Hattiesburg, which has direct connection with the seaports of New Orleans (117 miles), Mobile (97 miles), and Gulfport (70 miles).

7. *Improvement desired.*—The commercial interests of Hattiesburg desire an all-water route to the port of Pascagoula (Scranton), Miss., at which a dredged channel having a low-water depth of 17 feet has been constructed by the General Government. It is claimed that 100,000 bales of cotton and 100,000,000 feet board measure of lumber, now shipped by rail annually, could be shipped by river from Hattiesburg to Scranton were there sufficient depth, and an estimated saving to the community of $150,000 per year is argued. It is stated by the secretary of the Commercial Club that Hattiesburg is greatly discriminated against in the matter of freight rates, and comparison is made with the rates to Meridian, Miss., which is 135 miles from Mobile by rail. Data from the commercial clubs of Hattiesburg and Pascagoula herewith,[1] as Exhibits B, C, and D.

8. *Conclusions.*—Hattiesburg desires a waterway of 4 to 6 feet low-water depth and suitable width. While such a channel uniformly available during the greater part of the year would be of benefit to the community, the actual saving to be effected is problematical. It seems that the present discrimination in freight rates as compared with Meridian is due to other causes than the lack of water transportation and is rather a matter for adjustment with the several railroads. Hattiesburg's choice of three seaports for the export of her products should insure active competition and reasonable rates.

Under the present projects for improvement, a considerable commerce has developed on the streams in question. When the small and scattered allotments for the work of maintenance are considered, it is evident that these channels have not been maintained up to their maximum capacity. For several years at a time no work was done, the available funds being not sufficient to construct a suitable snag boat and the existing plant unable to do more than clear out the lighter obstructions. Recently a self-propelling snag boat has been built for use jointly on the Pascagoula, Leaf, and Tombigbee Rivers. It will be able to operate part of the time on the Pascagoula and lower Leaf; for the upper river, another snag boat of special design and ample lifting power must be provided. This has been recommended in the last annual report. It is my opinion, however, that two snag boats can be fully occupied with work on the Pascagoula, Leaf, and Chickasahay Rivers, Miss., which are now classed as one improvement in the appropriation acts. To satisfy this requirement, funds for the construction and continuous operation of two snag boats should be provided. Constant attention every season to the rivers under consideration is essential. If the removal of obstructions is carried on systematically and the lumbering interests will unite to prevent loose saw logs and deadheads entering the stream, I believe

[1] Not printed.

that the existing projects will produce channels sufficient for the present needs of tributary population and for a larger commerce than now exists. The prospective commerce may in time require more capacious channels; they can be created more cheaply and more intelligently if the preliminary work is well done.

In view of the above arguments relative to the present and prospective commerce and the possibilities of the existing projects for improvement, I am of the opinion that the locality in question is not worthy of improvement by the General Government further than in the manner and to the extent now authorized by the existing projects for improvement. I therefore recommend that no survey be made of the locality.

9. *Special subjects.*—None of the special subjects of inquiry mentioned in section 13 of the river and harbor act of March 3, 1909, are pertinent to this proposed improvement.

Respectfully submitted.

H. JERVEY,
Major, Corps of Engineers.

The CHIEF OF ENGINEERS, UNITED STATES ARMY
(Through the Division Engineer).

[First indorsement.]

OFFICE DIVISION ENGINEER, GULF DIVISION,
New Orleans, La., October 14, 1909.

1. Respectfully forwarded to the Chief of Engineers, United States Army.

2. The district officer appears to think that the project for improvement of these streams, if carried out with sufficient funds, will afford the desired commercial relief to the localities interested. It would appear advisable to give the plans already adopted a fair trial before making further and more expensive projects. If the communities affected by the waterways are found to be benefited by their improvement, and properly utilize them, the character and extent of further improvements can then be better determined than is possible at this date.

3. The improvements already planned should be fully made and given a trial before more expensive plans are prepared. With this view of the case, it is believed that the locality in question is, at this time, not worthy of improvement by the General Government further than already authorized.

LANSING H. BEACH,
Lieut. Col., Corps of Engineers,
Division Engineer.

[Third indorsement.]

BOARD OF ENGINEERS FOR RIVERS AND HARBORS,
Washington, D. C., November 8, 1909.

Respectfully returned to the Chief of Engineers, United States Army.

1. The existing project for the improvement of these streams contemplates the removal of obstructions and overhanging trees, covering a distance of about 100 miles in each stream. The Pasca-

goula is navigable for light-draft boats at stages slightly above low water, while the Leaf is available only for rafting and at stages above low water, the stream being used to a very limited extent for any other form of navigation. Those interested desire a reasonably permanent navigable channel 4 to 6 feet in depth.

2. The district officer and the division engineer are of opinion that if work under the existing project is vigorously prosecuted, and the rivers kept free from snags and obstructions, the present demands of commerce will be fairly well met, and that this project should be fully carried out before a more extensive improvement is undertaken.

3. Interested persons were notified of the adverse report of the district officer and invited to submit statements and arguments to the board bearing upon the questions involved, and at the request of Hon. E. J. Bowers, M. C., a hearing was given in the offices of the board on November 1, 1909, which was attended by Mr. Bowers and two representatives of the town of Hattiesburg, located on Leaf River near the head of the desired improvement.

4. From the statements and arguments presented, the board has arrived at the conclusion that a survey and estimate of cost should be made to determine the question of the advisability of any further improvement than is contemplated by the existing project. It is therefore recommended that a survey be authorized and that estimates be prepared for—

(*a*) Prosecuting the work vigorously under the existing project, with a view to clearing the river of snags and obstructions;

(*b*) For a channel of suitable width and 4 feet in depth;

(*c*) For a channel of suitable width and 6 feet in depth.

For the Board:

WM. T. ROSSELL,
Colonel, Corps of Engineers,
Senior Member Present.

[Fourth indorsement.]

WAR DEPARTMENT,
OFFICE OF THE CHIEF OF ENGINEERS,
Washington, November 15, 1909.

1. Respectfully submitted to the Secretary of War.

2. This is a report on preliminary examination of Leaf and Pascagoula Rivers, Miss., authorized by the river and harbor act of March 3, 1909.

3. Inviting attention to the report of the Board of Engineers for Rivers and Harbors in the preceding indorsement, I recommend that a survey of the locality and preparation of estimates, as proposed, be authorized.

W. L. MARSHALL,
Chief of Engineers, United States Army.

[Fifth indorsement.]

WAR DEPARTMENT, *November 16, 1909.*

Approved as recommended by the Chief of Engineers.

ROBERT SHAW OLIVER,
Assistant Secretary of War.

REPORT OF ASSISTANT ENGINEER J. M. PRATT.

WAR DEPARTMENT,
UNITED STATES ENGINEER OFFICE,
Mobile, Ala., September 24, 1909.

SIR: I have the honor to submit the following report of a preliminary examination of Leaf and Pascagoula Rivers, from the mouth of Bowie Creek to the junction of Pascagoula and Dog Rivers.

This examination was made in compliance with your directions and in accordance with the act of Congress approved March 3, 1909.

Geographical location.—Leaf River rises in Scott County, Miss., in the south-central portion of the State and flows in a southeasterly direction, emptying into Pascagoula River at Merrill, Miss., in the southern part of Greene County. The limits of the proposed improvement, however, and of the present project extend only up to Bowie Creek which empties into Leaf River at Hattiesburg, Miss. From this point the river runs southeast, flowing through Forrest, Perry, and Greene Counties.

The Pascagoula River is formed by the junction of the Leaf and Chickasahay Rivers and flows slightly east of a southerly direction, emptying into Mississippi Sound through two mouths, known as East and West Pascagoula Rivers. They are each about 40 miles long and empty into the sound about 3 miles apart, the Eastern Fork emptying into the sound at Scranton, and the western mouth at West Pascagoula, Miss. The Eastern Fork is much the better river, and is the one referred to throughout this report, it being the portion that is under improvement at the present time.

Previous examinations and surveys.—Report of a preliminary examination of Leaf River may be found in Annual Report of Chief of Engineers for 1889, page 1462. It is recommended in this report that a high-water channel for five months in the year may be formed by the removal of snags, logs, and overhanging trees at a cost not to exceed $25,000.

Preliminary examination report of Pascagoula River is on page 835 of Annual Report of Chief of Engineers for 1879. In this report it is estimated that $14,000 will be needed to remove the obstructions from Pascagoula River between its source and the mouth of Dog River.

History of improvement, appropriations, and expenditures.—The following is an extract from the Annual Report of the Chief of Engineers for 1909 (not yet printed):

"*Pascagoula River (above the mouth of Dog River).*—Before this improvement was commenced navigation was impossible on this section of Pascagoula River, except during period of high water. The minimum width of the channel was 60 feet and the minimum depth was 1 foot at mean low water, the stream being very much obstructed by snags and logs. The first project for this improvement, which was adopted in 1880, in addition to providing for dredging work at the mouth of the stream, described in the report on the improvement of Pascagoula River, Miss., contemplated the improvement of the river by the removal of snags and overhanging trees. Under this project the river was cleared of obstructions between 1882 and 1884, at a cost of $15,000. In 1886 the existing project for this improvement was adopted. This project provided for the maintenance of the channel above the mouth of the river by the removal of obstructions from the stream from time to time, but was modified in 1899, the extent of the improvement being limited at that time to the section of the river above Dog River, about 100 miles. The total amount expended on the existing project to June 30, 1909, was $29,380.97 all of which was applied to maintenance.

"On June 30, 1909, the Pascagoula River was navigable at low water for boats of 5-feet draft as far up as Cedar Creek, 55 miles, while above this point to the head of the river light-draft navigation was possible on a slight rise above low water.

"The Pascagoula River is nontidal, except in its lowest reaches.

"The report of the examination upon which the improvement was originally based is printed in the Annual Report of the Chief of Engineers for 1879, page 835.

"*Leaf River.*—Originally it was impracticable to navigate the river on account of snags, logs, and overhanging trees obstructing the channel. The minimum width of the stream was 100 feet and the minimum depth was 2½ feet at mean low water. The original project for this improvement was adopted in 1890, its purpose being to afford a channel for high-water navigation from Bowie Creek to the mouth of the river, a distance of 75 miles, by the removal of obstructions and overhanging trees. This project was completed in 1897 at a cost of $11,019.04, since which time expenditures have been in the direction of maintaining the improvement.

"The total amount expended on this improvement up to June 30, 1909, was $23,146.01, of which $12,126.97 was applied to maintenance. On June 30, 1909, the river was available for rafting on a fair rise above low water, being used to a very limited extent for any other form of navigation."

APPROPRIATIONS.

Pascagoula River, Miss.

Total to Dec. 31, 1902 (included in those for Pascagoula River shown on p. 283 of H. Doc. No. 421, 57th Cong., 2d sess., see also report immediately preceding this one)	$31,000
June 13, 1902 (allotment)	4,000
Mar. 3, 1905 (allotment)	6,750
Mar. 2, 1907 (allotment)	6,000
Total	47,750

Leaf River, Miss.

Total to Dec. 31, 1902 (as shown on p. 283 of H. Doc. No. 421, 57th Cong., 2d sess.)	19,750
Mar. 3, 1905	3,250
Mar. 2, 1907	2,500
Total	25,500

Physical characteristics.—The gasoline launch *Naomi* was used in making an examination of the present condition of these streams. This launch has a length of 33 feet, a breadth of 12 feet, and a draft of 3 feet. It was sent up by water from Scranton to Hattiesburg where the inspection was commenced, on the 10th of August, 1909, and continued downstream until the evening of the 13th of August when the mouth of Dog River was reached. Soundings were made at regular intervals and the results are shown on the accompanying sheet.[1] Generally where the shoals are represented deeper water could have been found to one side or the other, but it could not be followed on account of snags and logs. The banks of these rivers vary in quality of material from a light sandy soil that washes and caves easily to a stiff clay that stands upright. In height they vary from 10 to 40 feet above low water, except near the lower portion of the Pascagoula where the banks are flat and marshy. From the mouth of Bowie Creek to a point about 30 miles below, Leaf River is filled with snags and logs and gravel bars. No sooner does a bar end on one side of the river than another begins on the opposite side. As is the general rule in such rivers, at the upper and lower ends of these bars is where the shoalest water occurs. The banks over this portion are not stable and each overflow brings large numbers of obstructions into the stream. It is claimed that after the removal of snags and logs deeper water would form, and generally no doubt this would be the case. There are numerous sharp bends.

The remainder of Leaf River and all of Pascagoula River are in fair condition considering the small amount that has been expended and the length of time since any work has been done. In some places several miles of river exist where there is deep water, free from snags. The width of Leaf River at low water varies from 100 to 350 feet, and that of Pascagoula River, from 150 to 500 feet. The lower 50 miles of Pascagoula River are in good condition. There are 152 sand and gravel bars on Leaf River below Hattiesburg and 94 on Pascagoula River.

From Bowie Creek down to Cedar Creek the banks on either side are lined with forests of oak, gum, hickory, ash, and other hardwoods and further off are vast forests of pine.

The following table gives the tide gauge readings as indicated on United States Weather Bureau gauges at Hattiesburg and Merrill, Miss., the latter point being just below the mouth of Leaf River, and also the lowest readings recorded during the years 1905–1908 and the mean during the low-water months of those years as furnished by the United States Weather Bureau at Meridian, Miss.:

HATTIESBURG, MISS.

Date.	Mean reading.	Lowest recorded.
September, 1905	3.4	2.5
October, 1905	3.6	
November, 1905	3.4	
November, 1906	3.3	2.8
November, 1907	4.1	2.8
November, 1908	2.5	2.2
Aug. 10, 1909	[2] 4.15	.....

[1] Not printed.

[2] Reading.

MERRILL, MISS.

Date.	Mean reading.	Lowest recorded.
August, 1905	6.6	
September, 1905	2.3	
October, 1905	2.3	1.2
November, 1905	2.1	
August, 1906	2.9	
September, 1906	4.4	
October, 1906	13.7	1.6
November, 1906	3.6	
August, 1907	7.2	
September, 1907	5.7	
October, 1907	2.6	1.3
November, 1907	5.2	
August, 1908	5.3	
September, 1908	2.2	
October, 1908	.9	.5
November, 1908	1.0	
Aug. 13, 1909	[1] 6.33	.....

[1] Reading.

Freshets are of usual occurrence, and each brings into the stream large quantities of snags and logs. At Merrill just below the mouth of Leaf River an average of three overflows occurred per year during the past four years. It is therefore not surprising that navigation is impossible or dangerous on the Leaf and upper part of the Pascagoula Rivers, as such a comparatively small amount of work has ever been done on these streams.

In addition to the snags and trees brought into the river by each overflow, large quantities of loose saw logs are floated out of the swamps and lowlands where they have previously been cut for this purpose and allowed to drift down the river to some sawmill in this condition. Large numbers of these logs sink, and form obstructions in the river. Many more lodge against the bank and are left there when the water recedes.

From Bowie Creek to the mouth of Leaf River there are 10 fixed bridges as follows:

Name.	Place.	Kind.	Height above water.	Remarks.
			Feet.	
Bowie Creek Bridge	Forrest County, at Hattiesburg.	Steel, county bridge	26.6	
New Orleans & Northeastern R. R.	do	do	26.1	
River Avenue Bridge	do	do	23	Center pier in middle of river.
McCallum Bridge	Forrest County	do	25½	About 20 miles below Hattiesburg.
Choctaw Bridge	Perry County	do	24	About 35 miles below Hattiesburg.
New Augusta Bridge	do	do	29½	About 43 miles below Hattiesburg.
Windgate Bridge	do	do	29½	About 52 miles below Hattiesburg.
Mobile, Jackson & Kansas City R. R. Bridge.	do	Steel	30½	About 68 miles below Hattiesburg.
Beaumont County Bridge.	do	Steel, county bridge	26½	Do.
McLain Bridge	Greene County	do	31½	About 83 miles below Hattiesburg.

There is a railroad bridge across the Pascagoula River at Merrill, but it has a draw span which is being repaired so it will be in operation in a short time.

The length of Leaf River below the mouth of Bowie Creek is considered in this report to be 100 miles.

With the probable exception of the first three, which are at the upper end of the improvement, all of these bridges would of course have to be removed or provided with a draw span in order to permit of the passage of commerce.

Resources, industries, and commerce.—Leaf and Pascagoula Rivers run through a fertile country in the infancy of development. The forests along these rivers are still

filled with a large quantity of fine timber. As the forests are cleared, the land is being put into cultivation, and with the assistance of a little fertilizer raises large crops of cotton, corn, fruit, vegetables, sugar cane, oats, and potatoes.

Situated at the mouth of Bowie Creek, on Leaf River, is the town of Hattiesburg, a railroad center, with a population of 15,000. Within this town there are a number of industries, chief among which are several large sawmills, one of which is one of the largest in the South, a cotton compress, a large fertilizer factory, and other minor plants. The large number of county bridges bear evidence of the country being settled below this point.

At the lower end of the improvement is Pascagoula, a shipping port where the General Government has formed a channel with a depth of 17 feet. A large number of people and fertile extensive territory would be affected by the proposed improvement. As the difference in shipping direct by water and by rail would be considerable, the people along these streams desire that their principal products be shipped direct by water. The country tributary to the Leaf and Pascaguola Rivers is traversed by only one railroad, the Mobile, Jackson & Kansas City, and it only runs through a portion of this country.

Following is a tabulated statement prepared from data furnished by commercial bodies at Hattiesburg and Pascagoula, showing the present annual commerce by river and the amount shipped by rail that could be shipped by river if it were navigable.

Commerce on the Leaf River for the calendar year 1908.

Kind.	Tonnage.	Value.
General merchandise	60	$2,000
Logs	202,500	600,000
Hewn timber	10,800	36,000
Total	213,360	638,000

Commerce on Pascagoula River (above mouth of Dog River) during 1908.

Kind.	Tonnage.	Value.
Logs, timber, crossties, etc	272,027	$1,372,500
Turpentine	300	37,500
Rosin	1,000	22,500
Charcoal	12,000	150,000
General merchandise	5,000	225,000
Total	290,327	1,807,500

Shipped by rail annually that could be shipped by river from Hattiesburg.

Kind.	Tonnage.	Value.	Remarks.
Cotton	25,000	$5,000,000	100,000 bales.
Wool	138	82,500	
Hides	234	6,800	
Lumber [1]	200,000	1,000,000	100,000,000 feet board measure.
Total	225,372	6,089,300	

[1] This only includes that originating in Hattiesburg, 50 per cent of which is cut for export.

It is claimed that $150,000 could be saved annually on the lumber and cotton above originating in and around Hattiesburg if navigation were possible on the Leaf and Pascagoula Rivers.

Besides this, it would seem that Hattiesburg is greatly discriminated against in the way of freight rates. As stated by the secretary of the Hattiesburg Commercial Club, "The Illinois Central Railroad has been in position to dictate rates owing to the fact that the lines which would be willing to put Hattiesburg on a parity with Jackson and Meridian receive their inbound freight from the Illinois Central. This discrimination according to traffic sheets in force is as follows:

"From New York to Hattiesburg, via New Orleans, is $1.16.

"From New York to Meridian, via New Orleans, is $0.96.

"This freight is hauled through Hattiesburg to Meridian a further distance of 85 miles, making a discrimination of 20 cents per hundred, first class, and the second, third, fourth, and fifth class rates carry a corresponding discrimination.

"Taking a common point like Cincinnati, where the distance to Hattiesburg and Meridian are the same, and which based on all other rates, to cities of the same class would put Hattiesburg and Meridian on the same basis, the rates are as follows on the following classes and commodities:

	Hattiesburg.	Meridian.		Hattiesburg.	Meridian.
First class	$1.26	$1.06	Fourth class	$0.78	$0.66
Second class	1.09	.92	Fifth class	.64	.55
Third class	.93	.78	Sixth class	.54	.48

"The commodity rates, car-load lots, on the following commodities discriminate as follows:

	Hattiesburg.	Meridian.	Difference.
Canned goods, per hundred	$0.50	$0.41	$0.09
Farm implements	.54	.48	.06
Cotton bagging and ties	.36	.31	.05
Fruit jars	.52	.43	.09
Grain and grain products	.25	.205	.045
Flour	.285	.23	.055
Iron and hardware	.35	.29	.06
Meats and poultry, dressed	.62	.50	.12
Packing-house products	.395	.345	.05
Sewer pipe	.25	.20	.05
Plaster	.26	.21	.05
Stoves	.59	.50	.09
Tobacco	.93	.76	.17
Live stock, per car	126.00	106.00	26.00

"It is admitted that if the river were improved so that we could adjust the rates from New York, via New Orleans, Hattiesburg could be immediately relieved of the discrimination above set forth, resulting in a saving of at least $150,000 per annum on commodities affected by these rates."

Complete statistics could not be obtained but enough has been shown to warrant the statement that the proposed improvement means a great deal to the inhabitants along these rivers, especially to the people of Hattiesburg.

Nature of improvement desired.—The commercial interests desire a channel with a depth of 6 feet and a width of 60 feet, although they state that if this were too costly a channel with a depth of 4 feet would be of great benefit. Basing their opinion, however, upon information furnished by men who have had considerable experience on these rivers, they believe that a channel with the desired depth can be obtained principally by active snagging operations, combined with a small amount of dredging through the worst shoals.

Special subject of inquiry.—None of the special subjects mentioned in the act would be affected by the proposed improvement.

Conclusions.—The proposed improvement would cause a reduction of about 20 per cent in freight rates. The inhabitants of a large extent of fertile country would be greatly benefited. The cost of the improvement would no doubt be overbalanced by the saving to the people annually. As the present high-water channel will not answer the demands of commerce, it is respectfully recommended that a survey be made and plan and estimate of cost prepared for obtaining a low-water channel, with suitable depth and width. It is estimated that $8,000 would be needed for this purpose.

All papers and data obtained in the investigation of this subject are transmitted herewith.

Very respectfully submitted.

J. M. PRATT,
Assistant Engineer.

Maj. H. JERVEY,
Corps of Engineers.

SURVEY OF LEAF AND PASCAGOULA RIVERS, MISS.

UNITED STATES ENGINEER OFFICE,
Mobile, Ala., September 30, 1911.

SIR: 1. I have the honor to submit the following report on the survey of Leaf and Pascagoula Rivers, from the mouth of Bowie Creek to the junction of Pascagoula and Dog Rivers, directed by letter from the office of the Chief of Engineers, dated November 18, 1909. This survey was directed in the river and harbor act of March 3, 1909. Tracings of the survey, showing profile and topography in 114 sheets, are submitted herewith.[1]

2. Report on the preliminary examination of these rivers was submitted by Maj. Henry Jervey, Corps of Engineers, under date of October 11, 1909, and attention is invited to his report for information relative to commercial statistics, railroad rates, and general description of the streams.

3. For consideration of this report, the Board of Engineers for Rivers and Harbors requested that a survey be made and that estimates be prepared for—

(*a*) Prosecuting the work vigorously under the existing project, with a view to clearing the river of snags and obstructions.
(*b*) A channel of suitable width and 4 feet in depth.
(*c*) A channel of suitable width and 6 feet in depth.

4. A preliminary party was sent out in December, 1909, to locate bench marks, during the then low-water season. Actual survey began May 18, 1910, at the junction of Bowie Creek and Leaf River, 1 mile above Hattiesburg, Miss. The survey party consisted of three instrument men, five recorders, and the necessary number of boatmen, laborers, etc. It was provided with a quarter boat and five skiffs, and was successively in the charge of Messrs. Truman A. Smith, junior engineer; J. D. Ferguson, inspector; and C. A. Turrell, surveyor. The field work was completed October 26, 1910, at Moss Point, Miss., and the preparation of maps and reports was completed May 26, 1911. Some delays occurred, due to rises in the river and to sickness of members of the party. The total cost of the survey was $10,567.86. Mr. J. M. Pratt, assistant engineer, was in general charge of this survey, and extracts from his report and from that of Mr. C. A. Turrell, surveyor, are attached hereto.

5. Summary of the estimates prepared under the headings desired by the Board of Engineers for Rivers and Harbors is as follows:

(*a*) Completion of present project in two years:	
Work of improvement	$87,000
Annual maintenance	12,000
(*b*) For a 4-foot channel, 75 feet wide:	
Estimate No. 1, based on dredging by contract—	
Work of improvement	248,560
Annual maintenance	25,000
Estimate No. 2, based on executing dredging with combined Government plant, equipped for snagging and dredging—	
Work of improvement	110,500
Annual maintenance	15,000
(*c*) For a 6-foot channel, 75 feet wide:	
Work of improvement	485,200
Annual maintenance	90,000

[1] Index map only printed.

It would, of course, be practicable to secure suitable navigabl widths and depths on the rivers by canalization, but the cost thereo is prohibitive. The above estimates contemplate clearing the stream of snags and obstructions, dredging channels through the bars to a suitable depth, and maintaining the water levels and navigable veloc ities in these channels by small spurs and dikes.

6. The physical data in the accompanying reports show a very regular fall in the streams, diminishing toward the lower portion The following table shows the two streams, divided into sections of approximately equal length, numbered downstream from Bowie Creek, and gives lengths, slopes, average widths, and theoretical uniform velocities for these sections. The velocities are computed by Kutter's formula, assuming n = 0.03. This value is taken from similar conditions on other streams, as data are not available for its determination on Leaf and Pascagoula Rivers. Corresponding values of C vary from 65 to 67 for the 4-foot depth and from 69 to 77 for the 6-foot depth.

Section.	Length.	Fall.	Fall per 1,000 feet.	Low water, average width.	Low-water velocity:	
					6 feet.	4 feet.
	Feet.	*Feet.*		*Feet.*		
1	58,000	9.8	0.19	180	2.35	1.78
2	58,000	9.0	.18	180	2.32	1.72
3	58,000	18.0	.36	190	3.22	2.43
4	59,000	11.0	.19	200	2.35	1.78
5	56,000	8.0	.14	220	2.05	1.52
6	50,000	8.4	.17	220	2.23	1.65
7	56,000	10.0	.18	230	2.32	1.72
8	56,000	7.8	.14	250	2.05	1.52
9	48,000	6.4	.13	260	1.95	1.45
10	56,000	8.0	.14	300	2.05	1.52
11	58,000	5.8	.10	300	1.75	1.30
12	48,000	4.9	.10	300	1.75	1.30
13	56,000	.6	.011	350	.64	.43
14	56,000	.8	.015	350	.74	.50
15	42,000	.2	.005	350	.53	.38

These velocities presuppose complete regulation throughout each section, which is unattainable, but it is not believed that velocities obtainable by regulation at shoals would exceed those of the table in any section by more than 75 per cent, which would be entirely practicable for navigation. The maximum velocities computed indicate a low-water discharge on Leaf River for a 6-foot channel of 1,350 foot-seconds and for a 4-foot channel of 730 foot-seconds. A measured discharge on Leaf River with gage +0.2 have 828 foot-seconds. From these figures it appears probable that a 4-foot depth could be maintained by regulation works, but gives rise to grave doubts as to whether a 6-foot depth could be maintained in a 75-foot channel. The steepest slope on any shoal on these streams shows a fall of 2 feet in 2,000 feet.

7. A public hearing was held at Pascagoula, Miss., in the matter of this improvement on July 28, 1911, at which representatives of the various interests on the river were present. The lumber representatives were unanimous in expressions of willingness to abandon log driving and sack rafting on the streams if these could be properly improved. The county authorities expressed their readiness to make suitable alteration in existing bridges. The commercial interests of Hattiesburg pledged themselves to maintain a traffic

line on the improved river, and to provide permanently free public landing places at Hattiesburg and Merrill. It was apparent at the hearing that the demand for suitable improvement is great on these streams, based in the order of importance on (1) obtaining better transportation rates by the use of the river and by competition with the railroads, (2) a suitable depth and clear river for all-year rafting of logs, (3) obtaining a transportation line for the settlement and development of the cut-over timber lands now going to waste in the valley.

8. I believe that the streams are worthy of improvement by the United States to a limited extent, and recommend the adoption of the 4-foot project (Estimate No. 2). If adopted, funds should be made available for early completion, as the improvement will be of little or no value until continuous throughout. The work should begin at Hattiesburg and be carried downstream. Proper regulation for logging should be promulgated and follow the improvement, being effective at all times above the lower limit of the improved river and noneffective below that point, in order that log driving may not be suspended until the river is in suitable condition for rafting.

9. In my opinion the most economical method of work would be to complete the same in two years, involving an initial appropriation of $75,000 for the construction of plant and about six months operation, and an appropriation the following year of $35,500 to cover the remainder of the estimate. I would recommend that any enactment making appropriation under this project contain a proviso that no expenditure shall be made until the cities of Hattiesburg and Merrill have made provision for suitable permanent public landings at those places. All necessary changes in the bridges spanning the streams can be effected by the War Department during the two years of construction, by action under existing statute law.

10. If this project, or some other involving channel excavation and regulation, is not adopted for these streams, I recommend that work thereon be abandoned, as the present project produces little if any beneficial results, is a useless expenditure, and the estimated cost thereof is about 79 per cent of that of the project recommended.

11. There are no wharves or terminal facilities on these streams at present, as no occasion has arisen for their use, nor are there any mechanical appliances for handling freight. There is ample available space for wharves and landings at towns on the river, and provision should be made, as recommended above, for the reservation of suitable space for these purposes.

12. There has been no demand for water power along these streams. If a lock and dam system should ever be established it is unlikely that the water power developed would prove of much value, owing to the uniform slope and the probable advantage of low lifts, uneconomical for the generation of power.

13. Flood regulation is not deemed necessary on these streams, nor is it thought that the projected improvement will directly benefit adjacent lands.

Respectfully submitted.

C. A. F. FLAGLER,
Major, Corps of Engineers.

The CHIEF OF ENGINEERS, UNITED STATES ARMY
(Through the Division Engineer).

[First indorsement.]

OFFICE DIVISION ENGINEER, GULF DIVISION,
New Orleans, La., October 23, 1911.

1. Respectfully forwarded to the Chief of Engineers, United States Army.

2. A stream like the Leaf and Pascagoula Rivers consist of a series of pools and steeper portions. Kutter's formula when applied to a stream of this kind must necessarily give lower velocities than will be actually found locally at many points, and it is fair to believe that the velocities shown in the table will be actually considerably exceeded. The steeper portions, or shoals, are now formed largely by material lodged upon stumps or logs. Were these logs and shoals removed new shoals would form differing only somewhat in the character of the material. It is believed that if channel excavation and regulation be adopted at one point it will only remove the difficulty at that particular place and transfer it to some point a little farther downstream. Paragraph 10 of the report indicates the results which have been secured to date, and it is probable that similar results would follow channel excavation and regulation unless the work be done on an extravagant scale.

3. It does not appear to the division engineer that the commerce involved will justify the large expense necessary to do this work, and on this account the locality is not recommended for approval.

LANSING H. BEACH,
Lieut. Col., Corps of Engineers,
Division Engineer.

[For report of the Board of Engineers for Rivers and Harbors on survey, see page 3.]

REPORT OF ASSISTANT ENGINEER J. M. PRATT.

WAR DEPARTMENT,
UNITED STATES ENGINEER OFFICE,
Mobile, Ala., May 26, 1911.

SIR: 1. In compliance with your directions, I have the honor to submit the following letter descriptive of a survey of Leaf and Pascagoula Rivers made in accordance with instructions contained in department letter dated November 18, 1909.

2. Owing to the numerous swamps and large forests bordering these rivers, and the distance to be covered in a single low-water season, making it necessary to proceed at the rate of 1 to 2 miles per day, it was considered impracticable for the party to live ashore in camps, as their outfit would have to be hauled every two or three days and even then the party would be working at a disadvantage. A quarter boat was therefore constructed by hired labor during the spring of 1910 at Hattiesburg, the upper limit of the survey, and everything was in readiness to commence work at the beginning of the low-water season. The total cost of the construction of this boat was $906.77. The hull was strongly built and of such shape that after the completion of the survey, by removing the house, it could be used as a tender for a snagboat. This hull will be used during the coming low-water season by the snag boat *Escatawpa* which will operate on Leaf River. * * *

The survey was authorized in November, 1909, the latter part of the low-water season, too late to make the necessary preparations and commence work. Enough time, however, remained to obtain the elevation af the low-water surface from Hattiesburg to the mouth of Dog River, which was done by setting bench marks 4 or 5 miles apart, the elevations of which were referred to the water surface. At the same time records were obtained of the elevation of the water surface at Hattiesburg and Merrill as referred to the United States Weather Bureau gauges at those points. This data enabled the reduction of soundings to be made to the plane of mean low water

as established from records of several years kindly furnished by the United States Weather Bureau office, Meridian, Miss. At the beginning of the survey a tide gauge was set, the zero of which corresponded with the mean low water on the Hattiesburg gauge (U. S. Weather Bureau). This gauge was shifted from day to day as the party advanced, all soundings being reduced from it to the mean low-water plane, the bench marks previously set being used in checking it.

3. The plane adopted represented the average of the lowest readings as recorded by the United States Weather Bureau for the years 1905, 1906, 1907, 1908, and 1909 at Hattiesburg and Merrill which was 2.5 feet on the gauge at the former and 1 foot on that at the latter place as shown below:

Lowest recorded readings.

Year.	Hattiesburg.	Merrill.
	Feet.	*Feet.*
1905	2.5	1.2
1906	2.8	1.6
1907	2.8	1.3
1908	2.2	.5
1909	2.5	.6
Mean	2.5	1.0

This is sufficiently low in elevation, as the records show that the average height of the water during the low-water months for 1905 to 1910 was as follows:

Year.	Hattiesburg.				Merrill.			
	August.	September.	October.	November.	August.	September.	October.	November.
1905	4.6	3.4	3.6	3.4	6.6	2.3	2.3	2.1
1906	.....	.....	.....	3.3	3.0	4.4	13.7	3.6
1907	.....	.....	.....	4.1	7.2	5.7	2.6	5.2
1908	.....	.....	.....	2.5	5.3	2.2	.9	1.0
1909	.....	.....	.....	2.6	5.4	3.1	1.6	1.0
1910	2.8	2.4	2.7	2.7	2.7	.9	1.2	1.1
Mean	3.7	2.9	3.1	3.1	5.0	3.1	3.7	2.3

No records were obtained at Hattiesburg during August, September, and October, 1906, 1907, 1908, and 1909. During the four months of the six years covered by the records as shown above the water surface was below the adopted plane only 20 days at Hattiesburg and 98 days at Merrill, and during the entire time, as far as the records show, only 21 days at Hattiesburg and 104 days at Merrill. Therefore the soundings on the accompanying maps indicate the depths available practically throughout the year. These rivers are subject to considerable and rapid fluctuations. The lowest and highest waters recorded from 1905 to 1910 are as follows:

Year.	Hattiesburg.				Merrill.			
	Lowest.	Date.	Highest.	Date.	Lowest.	Date.	Highest.	Date.
1905	2.5	Jan. 4–5	20.5	Jan. 12	1.2	Sept. 30	23.4	Feb. 15.
1906	2.8	Nov. 8, 9, 13.	20.1	Mar. 21	1.4	Sept. 19	21.6	Mar. 25, 26.
1907	2.8	Apr. 4–6; Nov. 15–17.	19.8	May 18	1.3	Oct. 27, 31; Nov. 1.	21.8	May 21.
1908	2.3	Nov. 27–30; Dec. 1.	18.6	Feb. 16	.5	Oct. 21, 23	21.4	Feb. 20, 21.
1909	2.5	Nov. 1–2, 10–14, 18–19.	18.7	June 5	.6	Nov. 5, 8, 9, 10.	25.1	June 4.
1910	2.2	Nov. 1–5	11.5	May '21	.0	Nov. 2, 3, 4, 5.	15.7	July 8.

4. The field work of this survey was commenced on May 23 and completed October 24, 1910. The preparation of the final maps was not completed until April 4, 1911, and the compilation of estimates was not completed until the present time, as it was

considered desirable to have this part of the work done by the present office force whose time was partly taken up by other work. The cost of making this survey is as follows:

Cost of construction of quarter boat and 5 skiffs	$906.77
Cost of furnishings, bedding, etc., for quarter boat	501.51
Cost of field work of survey	7,186.95
Cost of office work and superintendence (with the possible exception of a few small bills)	1,972.63
Total	10,567.86

Number of miles of river covered by the survey, 160.96.
Total cost of survey per mile, $65.66.

The elevation of all contours and benchmarks on the accompanying maps are referred to mean low water in Mississippi Sound as established by the Coast and Geodetic Survey in 1885–86.

5. The work in the past on these rivers has been confined to the removal of obstructions and this could not be prosecuted vigorously and continuously during the low-water seasons on account of small appropriations. Up to the past season nothing but a small hand-power boat had ever worked on Leaf River and the Pascagoula River was only worked over occasionally. During the past year a small snag boat with steam capstan was constructed for work on the Leaf River. The comparatively small amount expended on each stream up to the present time is shown below:

LEAF RIVER.

Amount expended from 1890 to 1911	$29,699.08
Amount expended per year	$1,484.95
Length of river under improvement.....miles	78.86
Amount expended per year per mile (about)	$19.00

PASCAGOULA RIVER.

Amount expended from 1882 to 1911	$51,476.64
Amount expended per year	$1,838.45
Length of river under improvement.....miles	82.10
Amount expended per year per mile	$22.50

As these rivers flow through an almost unbroken forest, with each shifting of the bed there is a caving of trees. In addition to this, no system of rafting has even been followed. The timber men have always simply rolled their logs into the river, and those that did not sink and were not carried into a run out by an unusual freshet or left upon the bank by a sudden fall found their way to the mills at Moss Point, at the mouth of Dog River. The banks and beds of these streams, Pascagoula River in particular, are lined with saw logs. Every run out is filled with them. They are everywhere an evidence of reckless waste, wrong ideas of economy, and an utter disregard of the damage to a public waterway. It is believed that the only method of floating logs on these streams should be by the formation of rafts, each end of every log of which shall be properly secured. It is hardly possible to keep these rivers open for steamboat navigation even, at any cost, while the present method of floating loose logs is permitted. Therefore, on account of these two causes, namely, the bringing of trees into the streams by freshets and the method of floating logs, and principally the latter, the amounts appropriated in the past have been entirely inadequate to keep these rivers clear of obstructions. During a portion of the past low-water season two snag boats were working on these streams. From July 27 to December 23, 1910, the snag boat *Demopolis* worked upstream in Pascagoula River from Dead Lake to a point 20½ miles above, accomplishing the following:

Overhanging trees:	
Felled and cut up	5
Felled and pulled back	20
Trimmed	3
Logs cut up	1
Removed from river:	
Stumps	96
Snags	676
Logs	854
Trees	2
Piles	2
Cost of doing the above work	$4,556.05

The snag boat *Escatawpa* was constructed in the summer and fall of 1910, and from October 24 to December 31 she worked downstream over a distance of 7 miles, commencing at Hattiesburg. The work accomplished by this boat is as follows:

Logs removed from drift piles	25
Removed from river:	
Stumps	111
Snags	370
Logs	252
Cost of above work (including fitting up of boat)	$3,095.39
Cost of construction of snag boat	$3,257.68

Both of the above boats are nonpropelling, but have steam capstans. The snag boat *Escatawpa* was especially constructed so as to pass under the bridges on Leaf River at ordinary stages. It was noticed that no sooner were the logs and snags removed from a shoal than it would commence to deepen.

6. Some of the facts ascertained by the survey which may have some bearing on this subject are briefly stated below:

Distance by river from Hattiesburg to mouth of Leaf River	miles	78.86
From mouth of Leaf River to mouth of Dog River	do	82.10
Total distance from Hattiesburg to mouth of Dog River	do	160.96
Fall in Leaf River below Hattiesburg	feet	93.96
Fall in Pascagoula River	do	31.07
Distance above Dog River that the Pascagoula River is affected by ordinary tides	miles	32.00
Navigable depth over this distance	feet	8.00

Number of shoals in these rivers where there is a less mean low-water depth than 4 feet, 181.

Character of material forming these shoals, logs, snags, sand, and gravel.

Character of banks fairly stable, consisting principally of sandy loam and clay.

Least mean low-water depth along channel line 1.4 feet.

Discharge per second.

Locality.	Mean low water.	Extreme low water.
Leaf River:	*Feet.*	*Feet.*
At Hattiesburg	840	650
At its mouth	1,170	700
Pascagoula River at Merrill	1,960	1,080

Velocity.

Locality.	Water surface referred to mean low water plane.	Maximum velocity per second.
Leaf River:	*Feet.*	*Feet.*
At Hattiesburg	− 0.5	2.18
At its mouth	− .7	1.51
Do	+ 9.0	2.30
Pascagoula River at Merrill	− .7	1.91
Do	+11.0	3.55

	Feet.
Average width of Leaf River	150 to 200
Average width of Pascagoula River	200 to 350

The number, location, height, and clear opening of fixed bridges across Leaf River are as follows:

Name.	Distance below Bowie Creek.	Height above mean low water.	Clear opening between piers.	Location of piers.
	Miles.	*Feet.*	*Feet.*	
County highway	0	26.5	200	Edge of banks.
New Orleans & Northeastern R. R.	¾	29.0	205	Do.
County highway	1¾	25.3	140–175	Edge of banks and near center of stream.
Do	16½	25.8	215	Near each bank.
Do	28¼	27.3	205	Near either bank.
Do	33¼	31.3	150–170	One on either bank; center one on sand bar.
Do	39¾	34.2	215	On either bank.
New Orleans, Mobile & Chicago R. R.	47¾	33.6	195	Do.
County highway	47¾	27.5	215	Do.
Do	60¼	34.7	220	Do.

All of the above, with the exception of the upper two, which are right at Hattiesburg, or perhaps the upper three, the lower one being only 1 mile below, would have to be provided with draw spans before steamboat navigation could be carried on.

The nearest railroad to Leaf River is the New Orleans, Mobile & Chicago. It parrallels the river, and is from ¼ to 2½ miles from it all the way from Hattiesburg to Merrill. This railroad crosses Pascagoula River at Merrill, and is joined at Evanston, a few miles east of Merrill, by the Pascagoula Northern Railroad, which runs south to Pascagoula, Miss. The average distance of this road from the Pascagoula River is from 8 to 10 miles.

7. From deep water in the Gulf of Mexico to the mouth of Dog River, a channel has been formed by the Government having a mean low-water depth of 17 feet. From the mouth of Dog River to Dead Lake, a distance of 32 miles, there is a channel 8 feet deep over a navigable width. There is a minimum low-water depth over a navigable width between the latter point and Hattiesbrug of 1.4 feet; the distance is 129 miles, and the lift or difference in elevation of the mean low-water surface is 123.03 feet. The cost therefore of making slack-water navigation possible is so great that it is not considered here. It would probably be in excess of $3,000,000.

The question now suggests itself as to whether the prospective commerce demands an improvement of 129 miles of river where the maintenance will necessarily be great, and if so to what extent. The best way can not always be followed, even in the details, on account of cost. The deciding factor is the question of economy, and if it is found that enough can be accomplished to obtain certain results justified by the cost, even though the demands are only partially met, it may be accepted instead of the more costly method which, while meeting the demands entirely, is too expensive as compared with the benefits derived. There are some very sharp bends in Leaf River, but it is believed that with the proper depth boats of suitable size can follow them. As these rivers have a comparatively regular slope, being broken only by a series of small steps, the steepest of which is a fall of 2 feet in 2,000 feet, and as they have fairly stable banks it is believed that the depth could be increased to some extent over the shoals by the proper constructing and placing of jetties. The slope in the upper portion of Leaf River is however much greater than it is near its mouth or in Pascagoula River, and the results obtained by contraction would not be as great near Hattiesburg as they would near the mouth of the Leaf or in the Pascagoula River. However, some improvement could be obtained all along, and this, coupled with the increase in depth due to the removal of snags and logs, it is believed would give an average available depth during the low-water months of 4 feet, which would be ample for steamboat navigation during the greater part of the year.

On some of the shoals worked over on these rivers during the past season it was noticed that the depth was increased as much as 1 foot simply by the removal of snags and logs. The bed of the stream is composed generally of sand and gravel, which shifts very rapidly when not supported by snags and logs and when the force of the current is properly applied. Great care would have to be exercised as to the extent of the contraction work at the various shoals, as too much contraction would be worse than none. The jetties should in most cases extend a very short distance into the stream and should be only from 1 to 2 feet above the mean low-water plane. As there

is no rock available along these streams for the construction of jetties, and their construction with piling or cribs or mattresses would be very costly, it is believed that by piling the sunken logs and snags and trees, especially those having limbs on them, along the line of jetty, driving a few piling where necessary to hold them, and pumping sand and gravel on and between them, an economical and fairly substantial jetty could be built. In the first place the logs, trees, and snags taken from the bed of the stream by the snag boat would be water-soaked and would not float, and if enough are found with branches to them, no piling will be needed, as the roots and branches would sink into the sand and hold them, as they sometimes do in the middle of a stream, where they have been known to form an island. A second advantage would be that having these jetties near the shoals where the snags are most plentiful would make a convenient dumping ground for the snag boat. The third reason is that the material pumped from the shoal could be fully utilized.

8. Estimates have been made for the completion of the present project and for the formation of a channel 4 feet and 6 feet deep, having a width in either case of 75 feet in the Leaf and 100 feet in the Pascagoula River, with appropriate easements at sharp angles, and are given below:

COMPLETION OF PRESENT PROJECT.

Construction and equipment of two snag boats with steam capstans	$25,000
Cost of two barges	2,000
Cost of operating three boats two years in removing snags and logs (the *Escatawpa* now engaged on Leaf River with the two above)	60,000
Total	87,000

After the work is completed, it is believed that to keep the rivers clear of logs, snags, and trees will require the expenditure of about $12,000 per annum.

FORMATION OF A 4-FOOT CHANNEL.

Estimate No. 1.

Construction and equipment of one stern-wheel and two nonpropelling snag boats with steam capstans	$35,000
Construction of three attendant barges for these boats	3,000
Removal of logs and snags with four boats (one now on Leaf River) 1½ years	60,000
Cost of dredging a channel through the shoals to be 75 feet wide in Leaf River and 100 feet in Pascagoula, 1,088,000 cubic yards, at 12 cents	130,560
Cost of construction of jetties with brush and piling	20,000
Total	248,560

FORMATION OF 6-FOOT CHANNEL.

In addition to the amount of $98,000 for snagging and plant as shown above, in order to secure anything like a permanent channel, some form of locks and dams, vertical lifts, or inclines would have to be adopted, the cost of either of which would, it is believed, be prohibitive. However, the cost of the formation of the channel and the construction of jetties and removal of snags as shown for the 4-foot channel would be as follows:

Cost of plant and removal of obstructions and construction of only the jetties, as indicated for the 4-foot channel	$118,000
Dredging 3,060,000 cubic yards of material, at 12 cents per cubic yard	367,200
Total	485,200

The cost of maintenance of the 4-foot channel would be about $25,000 per year, and that of the 6-foot channel about $90,000 per year, and then it is doubtful if the latter could be kept open.

It is well to note, as before stated, that the beds of these rivers are composed principally of sand and gravel, which shifts easily and rapidly. Therefore ordinarily the shoals to a certain depth would be removed by snagging, by contraction work, or by a combination of the two. Those shoals that would require dredging in addition to the above would probably require constant maintenance work, or as a result of the improvement on these particular shoals a change would occur elsewhere, causing trouble. From the very great distance covered by the shoals that would have to

be removed to form the 6-foot channel and the fact that some of these individual shoals are of considerable length and not a mere ridge across the river, and from the general outline of the streams, the condition of the banks and bed, the slope, discharge, and velocity, it is not believed that these rivers would maintain a 6-foot channel with navigable width. It is doubtful if a 4-foot channel could be maintained; that is of course on the assumption that the river was kept clear of all logs and trees. But it is believed that snag boats fitted with small centrifugal sand pumps could keep the 4-foot channel open in connection with maintaining it, while the maintenance of the 6-foot channel would require the constant service of a small dredge, and, as before stated, then it may not be kept open. In fact, if the channel formed is made 75 feet wide, the low-water discharge would not be ample to preserve a depth of 6 feet. If it is decided to actually dredge a channel through every shoal, it would probably be more economical to construct a small hydraulic dredge with a pump about 12 inches in diameter. In the case of the 6-foot channel, this would be decidedly the most economical, while the construction and operation of a dredge in the formation of the 4-foot channel would probably amount to the estimate as given, which is for contract work.

9. It would seem, however, that a considerable amount could be saved and fairly good results obtained by equipping each snag boat with a centrifugal sand pump of convenient size, about 8 inches in diameter, with the necessary dischage pipe. On each shoal where a jetty is desired, the snag boat could first construct the jetty of logs, trees and brush, and a few piling by using the material obtained in snagging, and then pump sand and gravel over it. The pump would need no cutter arrangement, as its suction would be sufficient to pick up all the material that could be forced through the discharge pipe. The suction would be fed by swinging it back and forth on the end of a boom. One or two such pumps are in use on snag boats in this district and have been used successfully in constructing dams across run-out bayous in Pearl River. If work is undertaken in this manner, the coast would be approximately as follows:

FORMATION OF A 4-FOOT CHANNEL.

Estimate No. 2.

Constructing and equipping one stern-wheel and two nonpropelling snag boats, having steam capstans	$35,000
Constructing three attendant barges for these boats	3,000
Purchase of four 8-inch centrifugal pumps with connections, discharge pipe, etc. (one for the boat already built)	5,000
Removal of logs and snags with 4 boats, 1½ years	60,000
Cost of extra time allowed for pumping sand and gravel on jetties and placing logs and trees already obtained by snagging, and driving a few extra piling where needed	7,500
Total	110,500

In all the estimates for construction of jetties it has been assumed that an average jetty 400 feet long and 4 feet high would be needed at every shoal. It is estimated that about one-half of the material forming these jetties would be sand and gravel, the other part being snags obtained from the river bed in the course of snagging work and some brush and piling. Of course its length and height would vary with every shoal perhaps, but it is believed that the above estimate will be sufficient for this style of jetty. In estimate No. 1 for construction of jetty for a 4-foot channel and for the jetty for the 6-foot channel the cost is greater than the above estimate, as it is proposed to use a large amount of piling and lumber, as there may be some question as to the use of logs, brush, and a few piling, as indicated for estimate No. 2, making a substantial jetty.

10. The number of boats that it is proposed to use on these streams may seem large, but it is believed that only by vigorous operations with a view to completing the work in a definite time, not too far distant, can any effective results be accomplished or steamboat navigation attracted. The three nonpropelling snag boats could each do as much work as the one fitted with self-propulsion in rivers like these, where obstructions are so numerous and moves of any distance very rare. As far as the actual snagging work is concerned they all may be nonpropelling, but some towing would probably be needed at times, or other work requiring long trips, and on this account it is considered advisable to have one self-propelling snag boat on these streams.

It is estimated that after the work of improvement is completed the maintenance work will require the service of two boats, properly fitted with pumps, removing obstructions and repairing jetties. The other two boats used in making the improvement would be needed to replace two old snag boats used elsewhere in the district

which will probably be unfit for service by that time. Therefore the cost of the improvement would not be as great as shown by almost the full value of the boats.

11. As previously stated, there are 10 fixed bridges between the mouth of Dog River and Bowie Creek. All of these bridges are situated on Leaf River. As the upper three are within 1 mile of Hattiesburg, it is not believed that it would be necessary to install draw spans in them, and the limit of improvement might therefore only extend to the lower of these bridges, which is a county highway bridge called the River Avenue Bridge. This would eliminate one railroad and two county bridges. Of the remaining seven, one is a railroad bridge, crossing the river at Beaumont; the others belong to Forest, Perry, and Greene Counties. These bridges range in height above mean low water from 25.8 to 34.7 feet. It is therefore evident that draw spans will have to be put in before any steamboat navigation could be successfully accomplished or before any capital would be invested in it. It is believed that these changes will cost the people of the counties interested and the New Orleans, Mobile & Chicago Railroad Co. over $100,000. But as it is claimed that the improvement of these rivers would mean a least saying of $150,000 annually to the people (see preliminary examination report), the cost of making these changes would be quickly returned. It is therefore respectfully recommended that funds for the improvement be provided with the understanding that no work will be done until the required clear opening (70 feet is considered sufficient) be made in all these bridges.

* * * * * * *

13. Considering the benefits to be derived by the people along these rivers and the amount that can be accomplished even by vigorous snagging operations, it is believed that the saving to the people would justify the expenditure of the amount as shown in estimate No. 2 for the formation of a 4-foot channel. If, however, it is decided that these streams are not worthy of the provision of necessary funds for vigorous work, it is respectfully recommended that work on them be discontinued altogether, as the present rate of doing work under the small appropriations does little or no good.

As the people along the Leaf River, especially at Hattiesburg, would be the chief beneficiaries, it is believed that any project decided upon should be made continuous in depth from the mouth of Dog River to Hattiesburg. The total amount necessary to obtain a channel 4 feet deep as shown in estimate No. 2 is $110,500, and it is believed that it would be better were the entire amount appropriated at one time, though perhaps only enough could be expended the first year as would be necessary for the purchase of plant, construction of boats, and for their operation for six months, or about $63,000 if the above work is decided upon; but it is recommended that such appropriation be made with the understanding that no work will be done until the required clear opening is made in the seven bridges on Leaf River below Hattiesburg.

Very respectfully,

J. M. Pratt, *Assistant Engineer.*

Maj. C. A. F. Flagler,
Corps of Engineers.

REPORT OF MR. C. A. TURRELL, SURVEYOR.

Mobile, Ala., *January 10, 1911.*

Sir: I have the honor to submit to you the following report of the results of the survey recently completed of Leaf and Pascagoula Rivers.

* * * * * * *

The Bowie River is a tributary of the Leaf and furnishes about the same amount of water. The actual survey work began on the 18th of May. The party was first in immediate charge of Truman A. Smith, junior engineer, beginning with the construction of the quarter boat and extending to June 18, one month. He was then succeeded by J. D. Ferguson, inspector, who was in charge from June 18 to July 20, when he was relieved by C. A. Turrell, surveyor, who conducted the party until the end of the survey at Moss Point, Miss., October 26, 1910. The party consisted of the surveyor in charge, as transitman, M. S. Long and L. C. Smith, levelmen, W. W. Toxey, principal recorder in charge of soundings and topography, 4 recorders acting as rodmen and surveymen; in addition a sufficient number of boatmen were employed to handle the five skiffs used and to move the quarter boat daily.

* * * * * * *

Leaf River after joining the Bowie pursues a very crooked course through Forest, Perry, and Greene Counties and touching the new county, George, at the edge of which it joins the Chickasahay River, a stream of almost equal size, with which it unites to form the Pascagoula River one-half mile above the town of Merrill, Miss.

Pascagoula River flows across George and Jackson Counties, Miss., and empties into Mississippi Sound near Pascagoula, formerly Scranton, Miss. The width of Leaf River is from 150 to 200 feet, in characteristic reaches 170 feet. The width of Pascagoula River is from 200 to 350 feet, widening to 500 feet about 2 miles above Moss Point, where Dog River joins it. Leaf River is 78.86 miles long from Hattiesburg to its junction with the Chickasahay, and the Pascagoula is 82.10 miles long to Moss Point, making a total length of river surveyed of 160.96 miles.

The banks of both the Leaf and the Pascagoula are almost continuously bordered by woods, the exceptions being an occasional small area cleared for a log landing and a very few old fields. The cultivated fields near the river banks do not number more than a dozen in all. There are, however, a number of small towns or villages along the river, which have cleared landings for the convenience of sawmills, and at most of these towns there are bridges across the river.

Hattiesburg is a city of nearly 12,000 (census of 1910) and has railroad connections by the New Orleans, Mobile & Chicago Railroad and the New Orleans & Northeastern Railroad. The first-named railroad parallels the Leaf River from Hattiesburg down.

On Leaf River below Hattiesburg are the towns of McCallum, Belleville, Mahned, New Augusta, Wingate, and McLain. On the Pascagoula are Merrill, Benndale, and several smaller, the latter situated 2 or 3 miles from the river with ferry roads. The total distance by river is 161 miles; on a direct line by land, 77 miles, and by the shortest railroad route, 96 miles. The depth of the Leaf at ordinary low water varies from 12 to 15 feet in pools to from 1 to 3 feet at shoals. The material of the river bed is alluvial, consisting of mud, clay, and sand, the clay occurring often in banks, washed almost perpendicular by current, especially at certain sharp bends, where it lies in sufficient hardness to resist a rapid scour. The sand has been deposited in extensive bars lying generally immediately below sharp bends in the river, and are quite numerous, often changing position by action of spring floods, causing marked changes in the river bed and consequent depth of water from one season to another. The river banks are from 20 to 30 feet high on the Leaf and 15 to 18 on the Pascagoula; in a few cases the clay bluffs are from 50 to 75 feet high.

On the lower end of the Pascagoula for 15 miles the banks are less than 10 feet high. The river bottoms are from one-fourth to 2 miles wide, generally low and frequently consisting of swamp. In the dry season the bottoms are passable. There are frequent small chutes, called cut-offs, leaving the river and rejoining it some miles below or entering some tributary creek, making a network of small channels containing little water except at flood seasons. In order to prevent logs of valuable timber from lodging in these cut-offs a row of piling has usually been driven at their head to keep the logs from leaving the main river.

Most of the slope of these rivers is concentrated in the bars of sand and clay. The river bed is all so soft that no sudden falls are found, as frequently occurs in rivers of rocky bed. The total fall of water surface at low water is 125.03 feet, from Hattiesburg to Moss Point. Of this fall, 93.96 feet is in Leaf River, at a mean rate of 1.192 feet per mile and 31.07 feet in Pascagoula River, a mean fall of 0.378 foot per mile. The principal fall in the Pascagoula is above Dead Lake, near which the lunar tides begin to show. From the head of the Pascagoula, 50 miles to Dead Lake, the slope is 0.58 foot per mile, but from Dead Lake to the mouth of the river it is only 0.05 foot per mile, at mean low tide, the only time the slope is appreciable. At Dead Lake the daily tide is 1.25 feet. From Dead Lake, a distance of 32 miles above Moss Point, a depth of 10 feet is available at mean low water with a channel width of 100 feet, and from Brewton (1.6 miles below Dead Lake) down, the available depth is 12 feet. This depth if needed could be extended to Dead Lake at small cost. At Dead Lake two large streams enter the Pascagoula, Black Creek and Red River, and their confluence forms a basin 2 miles long from the Pascagoula. This is a prominent point at which many saw logs are collected and floated or towed down to Moss Point.

The following table shows in detail the different localities on the river in order, their distance from the initial point of survey, length of pools and shoals, fall in each shoal and total fall from point of beginning survey, characteristics of river bed at shoals and approximate amount of excavation required. These estimates of excavation are based on proposed channels 4 feet and 6 feet deep and 75 feet wide, from Hattiesburg to the mouth of the Leaf. The same depths with 100 feet width of channel is proposed from the mouth of the Leaf to Dead Lake. From Hattiesburg to the bridge at Mahned, the obstructions occur more frequently than from Mahned to the mouth of the Leaf. At one locality on the Leaf a cyclone crossed several years ago, filling the river at that point with timber blown from the bank.

The distances were measured by use of the stadia rod observed with a Berger transit. The sights along the river bank were part of a traverse line; sights averaged

1,000 feet. The true bearings of the lines were checked by meridian observations on Polaris, each week or oftener, and azimuths corrected when necessary. A duplicate line of levels was run to determine slopes of the water surface. These were reduced to a low-water plane by an observed gauge carried with the party, compared with the permanent United States gauge readings at Merrill, Miss. The leveled slope terminates at mean tide level at Moss Point, which mean level at low tide is 125.03 feet below low-water surface at Hattiesburg.

Soundings were taken by stretching a graduated line across the river at each section and sounding at 20-foot intervals. Topography was taken with a hand level and rods, and the figures given on the contours, as shown in detail sketch, show the heights of each contour above mean low tide at Moss Point.

Estimate of yardage to be removed to give a 4-foot channel at mean low water, allowing 1 foot over depth, channel 75 feet wide.

Name of locality.	Distance from initial point of survey.	Length of pool.	Length of shoal.	Fall in each shoal.	Total fall from initial point to foot of shoal.	Character of river bed.	Excavation.
	Miles.	*Miles.*	*Miles.*	*Feet.*	*Feet.*		*Cu. yds.*
Hattiesburg, Bowie Creek Bridge.	0.00	.....	.....	.....	.....	.....	.....
Pool below	.00	0.19	.....	.....	.....	.....	.....
Shoal No. 1	.19	.....	0.04	0.01	0.06	Sand	2,404
Pool below	.23	.62	.....	.....	.....	.....	.....
Shoal No. 2	.85	.....	.45	.33	.60	Sand	7,210
Pool below	1.30	.69	.....	.....	.....	.....	.....
Shoal No. 3	1.99	.....	.54	.11	1.19	Sand	7,569
Pool below	2.53	.28	.....	.....	.....	.....	.....
Shoal No. 4	2.81	.....	.24	.39	1.99	Sand	7,406
Pool below	3.05	.20	.....	.....	.....	.....	.....
Shoal No. 5	3.25	.....	.04	.06	2.38	Sand	1,623
Pool below	3.29	.21	.....	.....	.....	.....	.....
Shoal No. 6	3.50	.....	.28	.40	3.12	Sand	8,326
Pool below	3.78	.45	.....	.....	.....	.....	.....
Shoal No. 7	4.23	.....	.08	.12	3.85	Sand	5,268
Pool below	4.31	.35	.....	.....	.....	.....	.....
Shoal No. 8	4.66	.....	.09	.13	4.47	Sand	2,120
Pool below	4.75	.13	.....	.....	.....	.....	.....
Shoal No. 9	4.88	.....	.34	.04	4.72	Sand	12,677
Pool below	5.22	.35	.....	.....	.....	.....	.....
Shoal No. 10	5.57	.....	.11	.24	5.14	Sand	4,162
Pool below	5.68	.22	.....	.....	.....	.....	.....
Shoal No. 11	5.90	.....	.12	.27	5.89	Sand	3,577
Pool below	6.02	.13	.....	.....	.....	.....	.....
Shoal No. 12	6.15	.....	.38	.83	6.97	Sand	12,214
Pool below	6.53	.11	.....	.....	.....	.....	.....
Shoal No. 13	6.74	.....	.34	.81	8.20	Sand	11,991
Pool below	7.08	.61	.....	.....	.....	.....	.....
Shoal No. 14	7.69	.....	.15	.20	9.64	Sand	2,713
Pool below	7.84	.44	.....	.....	.....	.....	.....
Shoal No. 15	8.28	.....	.41	.56	10.77	Sand	13,203
Pool below	8.69	.15	.....	.....	.....	.....	.....
Shoal No. 16	8.84	.....	.21	.28	11.25	Sand	4,669
Pool below	9.05	.14	.....	.....	.....	.....	.....
Shoal No. 17	9.19	.....	.68	1.68	13.15	Sand	18,883
Pool below	9.87	.23	.....	.....	.....	.....	.....
Shoal No. 18	10.10	.....	.25	.70	14.21	Sand	3,875
Pool below	10.35	.05	.....	.....	.....	.....	.....
Shoal No. 19	10.40	.....	.33	.46	14.75	Sand	2,778
Pool below	10.73	.06	.....	.....	.....	.....	.....
Shoal No. 20	10.79	.....	.79	1.11	15.94	Sand	14,620
Pool below	11.58	.35	.....	.....	.....	.....	.....
Shoal No. 21	11.93	.....	.22	.27	16.68	Clay-mud	6,494
Pool below	12.15	.57	.....	.....	.....	.....	.....
Shoal No. 22	12.72	.....	.22	.27	17.66	Sand	9,724
Pool below	12.94	.25	.....	.....	.....	.....	.....
Shoal No. 23	13.19	.....	.67	1.76	19.92	Sand	12,607
Pool below	13.86	.20	.....	.....	.....	.....	.....
Shoal No. 24	14.06	.....	.09	.17	20.44	Sand	1,927
Pool below	14.15	.15	.....	.....	.....	.....	.....
Shoal No. 25	14.30	.....	.10	.16	20.84	Sand	3,407
Pool below	14.40	.08	.....	.....	.....	.....	.....
Shoal No. 26	14.48	.....	.22	.36	21.34	Sand-gravel	3,760
Pool below	14.70	.16	.....	.....	.....	.....	.....
Shoal No. 27	14.86	.....	.24	.39	22.00	Sand-gravel	6,289
Pool below	15.10	.33	.....	.....	.....	.....	.....

Estimate of yardage to be removed to give a 4-foot channel at mean low water, allowing 1 foot over depth, channel 75 feet wide—Continued.

Name of locality.	Distance from initial point of survey.	Length of pool.	Length of shoal.	Fall in each shoal.	Total fall from initial point to foot of shoal.	Character of river bed.	Excavation.
	Miles.	*Miles.*	*Miles.*	*Feet.*	*Feet.*		*Cu. yds.*
Shoal No. 28	15.43	.....	0.13	0.21	22.76	Sand-gravel.	3,255
Pool below	15.56	0.16	.....	.....	.....	.....	.....
Shoal No. 29	15.72	.....	.08	.13	23.14	Sand-gravel.	2,298
Pool below	15.80	.14	.....	.....	.....	.....	.....
Shoal No. 30	15.94	.....	.06	.10	23.48	Sand	1,265
Pool below	16.00	.29	.....	.....	.....	.....	.....
Shoal No. 31	16.29	.....	.16	.19	24.37	Sand	5,270
Pool below	16.45	.37	.....	.....	.....	.....	.....
McCullum Bridge	16.53	.....	.....	.....	.....	.....	.....
Shoal No. 32	16.82	.....	.21	.58	25.37	Clay and sand.	8,303
Pool below	17.03	.40	.....	.....	.....	.....	.....
Shoal No. 33	17.43	.....	.18	.48	26.51	Sand	6,392
Pool below	17.61	.27	.....	.....	.....	.....	.....
Shoal No. 34	17.88	.....	.28	.83	28.18	Sand	10,119
Pool below	18.16	.20	.....	.....	.....	.....	.....
Shoal No. 35	18.36	.....	.13	.07	28.35	Sand	4,357
Pool below	18.49	.27	.....	.....	.....	.....	.....
Shoal No. 36	18.76	.....	.58	.58	29.07	Sand	15,268
Pool below	19.34	.11	.....	.....	.....	.....	.....
Shoal No. 37	19.45	.....	.10	.15	29.40	Sand	3,020
Pool below	19.55	.07	.....	.....	.....	.....	.....
Shoal No. 38	19.62	.....	.64	.97	30.47	Sand	12,571
Pool below	20.26	.13	.....	.....	.....	.....	.....
Shoal No. 39	20.39	.....	.24	.69	31.36	Sand	7,056
Pool below	20.63	.11	.....	.....	.....	.....	.....
Shoal No. 40	20.74	.....	.33	1.14	33.16	Sand	11,131
Pool below	21.07	.07	.....	.....	.....	.....	.....
Shoal No. 41	21.14	.....	.10	.04	33.23	Mud and sand.	5,148
Pool below	21.24	.06	.....	.....	.....	.....	.....
Shoal No. 42	21.30	.....	.14	.06	33.32	Mud and sand.	2,005
Pool below	21.44	.27	.....	.....	.....	.....	.....
Shoal No. 43	21.71	.....	.81	.67	34.10	Mud and Clay.	21,979
Pool below	22.52	.10	.....	.....	.....	.....	.....
Shoal No. 44	22.62	.....	1.10	1.83	36.07	Mud	14,975
Pool below	23.72	.26	.....	.....	.....	.....	.....
Shoal No. 45	23.98	.....	.25	.76	37.29	Mud and clay.	7,306
Pool below	24.23	.13	.....	.....	.....	.....	.....
Shoal No. 46	24.36	.....	.29	.44	37.95	Mud and clay.	7,995
Pool below	24.65	.24	.....	.....	.....	.....	.....
Shoal No. 47	24.89	.....	.56	.92	39.39	Sand and gravel.	8,278
Pool below	25.45	.07	.....	.....	.....	.....	.....
Shoal No. 48	25.52	.....	.30	.27	39.73	Sand	5,702
Pool below	25.82	.09	.....	.....	.....	.....	.....
Shoal No. 49	25.91	.....	.35	.32	40.14	Sand	7,144
Pool below	26.25	.12	.....	.....	.....	.....	.....
Shoal No. 50	26.37	.....	.64	1.28	41.53	Mud	11,135
Pool below	27.01	.03	.....	.....	.....	.....	.....
Shoal No. 51	27.04	.....	.04	.08	41.68	Mud	1,926
Pool below	27.08	.07	.....	.....	.....	.....	.....
Shoal No. 52	27.15	.....	.49	.78	42.59	Sand	5,724
Pool below	27.64	.11	.....	.....	.....	.....	.....
Shoal No. 53	27.75	.....	.07	.15	42.87	Sand	1,375
Pool below	27.82	.10	.....	.....	.....	.....	.....
Shoal No. 54	27.92	.....	.34	.92	44.05	Sand	4,711
Mahned Bridge	28.20	.....	.....	.....	.....	.....	.....
Pool below	28.26	.12	.....	.....	.....	.....	.....
Shoal No. 55	28.38	.....	.10	.26	44.64	Sand	2,468
Pool below	28.48	.06	.....	.....	.....	.....	.....
Shoal No. 56	28.54	.....	.10	.26	45.03	Sand	4,260
Pool below	28.64	.44	.....	.....	.....	.....	.....
Shoal No. 57	29.08	.....	.71	1.99	47.80	Mud	24,630
Pool below	29.79	.21	.....	.....	.....	.....	.....
Shoal No. 58	30.00	.....	.53	1.18	49.45	Mud	13,749
Pool below	30.53	.56	.....	.....	.....	.....	.....
Shoal No. 59	31.09	.....	.25	.13	50.47	Mud and clay.	9,780
Pool below	31.34	.07	.....	.....	.....	.....	.....

Estimate of yardage to be removed to give a 4-foot channel at mean low water, allowing 1 foot over depth, channel 75 feet wide—Continued.

Name of locality.	Distance from initial point of survey.	Length of pool.	Length of shoal.	Fall in each shoal.	Total fall from initial point to foot of shoal.	Character of river bed.	Excavation.
	Miles.	*Miles.*	*Miles.*	*Feet.*	*Feet.*		*Cu. yds.*
Shoal No. 60	31.41		0.57	0.30	50.80	Clay	14,414
Pool below	31.98	1.62					
New Augusta Bridge	33.33						
Shoal No. 61	33.60		.40	.52	52.49	Mud	9,582
Pool below	34.00	.02					
Shoal No. 62	34.02		.57	.88	53.40	Sand	7,354
Pool below	34.59	.07					
Shoal No. 63	34.66		.13	.17	53.66	Clay	5,888
Pool below	34.79	.69					
Shoal No. 64	35.48		.13	.07	54.45	Clay	4,954
Pool below	35.61	.30					
Shoal No. 65	35.91		.12	.09	54.71	Clay	4,877
Pool below	36.03	.24					
Shoal No. 66	36.27		.15	.19	55.24	Clay	5,479
Pool below	36.42	.14					
Shoal No. 67	36.56		1.38	1.34	56.65	Mud	23,506
Pool below	37.94	.03					
Shoal No. 68	37.97		.16	.51	57.20	Mud	6,676
Pool below	38.13	.73					
Shoal No. 69	38.86		.33	.62	58.87	Mud	8,558
Pool below	39.19	.13					
Shoal No. 70	39.32		.42	.63	59.71	Clay	5,430
Pool below	39.74	2.20					
Wingate Bridge	39.94						
Shoal No. 71	41.94		.18	.27	60.45	Sand	6,543
Pool below	42.12	.38					
Shoal No. 72	42.50		.14	.15	61.06	Mud	6,553
Pool below	42.64	.01					
Shoal No. 73	42.65		.44	.47	61.54	Sand	8,093
Pool below	43.09	.24					
Shoal No. 74	43.33		.88	1.21	63.14	Sand	9,449
Pool below	44.21	3.06					
Shoal No. 75	47.27		.20	.01	64.42	Sand	7,435
Pool below	47.47	.65					
Beaumont Railroad Bridge	47.72						
Beaumont Highway Bridge	47.75						
Shoal No. 76	48.12		.08	.01	64.45	Clay and sand.	3,584
Pool below	48.20	1.18					
Shoal No. 77	49.38		.20	.19	64.98	Clay and sand.	6,611
Pool below	49.58	.44					
Shoal No. 78	50.02		.47	.40	65.95	Sand	12,166
Pool below	50.49	1.15					
Shoal No. 79	51.64		.11	.10	67.22	Sand	1,702
Pool below	51.75	.65					
Shoal No. 80	52.40		.25	.21	68.74	Sand	6,669
Pool below	52.65	1.28					
Shoal No. 81	53.93		.09	.12	70.48	Sand	2,230
Pool below	54.02	.50					
Shoal No. 82	54.52		.21	.24	71.31	Mud	7,132
Pool below	54.73	.12					
Shoal No. 83	54.85		.32	.39	71.87	Sand	10,266
Pool below	55.17	.25					
Shoal No. 84	55.42		.24	.30	72.47	Sand	5,661
Pool below	55.66	.20					
Shoal No. 85	55.86		.10	.12	72.82	Sand	3,792
Pool below	55.96	.56					
Shoal No. 86	56.52		.37	.58	73.81	Sand	13,090
Pool below	56.89	.19					
Shoal No. 87	57.08		.20	.19	74.29	Mud	8,241
Pool below	57.28	.03					
Shoal No. 88	57.31		.23	.21	74.53	Sand	8,365
Pool below	57.54	1.90					
Shoal No. 89	59.44		.08	.03	75.94	Sand	2,495
Pool below	59.52	1.04					
McLain Highway Bridge	60.29						
Shoal No. 90	60.56		.46	.31	76.85	Sand	10,264
Pool below	61.02	1.49					
Shoal No. 91	62.51		.42	.05	77.32	Sand	13,112
Pool below	62.93	1.07					
Shoal No. 92	64.00		.07	.07	78.48	Sand	4,479
Pool below	64.07	.29					

Estimate of yardage to be removed to give a 4-foot channel at mean low water, allowing 1 foot over depth, channel 75 feet wide—Continued.

Name of locality.	Distance from initial point of survey.	Length of pool.	Length of shoal.	Fall in each shoal.	Total fall from initial point to foot of shoal.	Character of river bed.	Excavation.
	Miles.	*Miles.*	*Miles.*	*Feet.*	*Feet.*		*Cu. yds.*
Shoal No. 93	64.36		0.32	0.21	78.89	Sand	8,304
Pool below	64.68	0.11					
Shoal No. 94	64.79		.31	.59	79.45	Sand	7,769
Pool below	65.10	.26					
Shoal No. 95	65.36		.08	.19	80.61	Sand and mud.	1,147
Pool below	65.44	.11					
Shoal No. 96	65.55		.27	.41	81.19	Sand	2,967
Pool below	65.82	.14					
Shoal No. 97	65.96		.07	.07	81.51	Sand	3,472
Pool below	66.03	.17					
Shoal No. 98	66.20		.15	.17	81.90	Sand	4,070
Pool below	66.35	.16					
Shoal No. 99	66.51		.24	.24	82.32	Sand	7,704
Pool below	66.75	.28					
Shoal No. 100	67.03		.29	.01	82.34	Sand	12,280
Pool below	67.32	.26					
Shoal No. 101	67.58		.10	.13	82.55	Sand	1,844
Pool below	67.68	.36					
Shoal No. 102	68.04		.02	.01	82.82	Sand	1,070
Pool below	68.06	.30					
Shoal No. 103	68.36		.14	.24	83.05	Sand	4,611
Pool below	68.50	.17					
Shoal No. 104	68.67		.09	.05	83.37	Sand	2,689
Pool below	68.76	.34					
Shoal No. 105	69.10		.08	.04	83.60	Sand	2,167
Pool below	69.18	.03					
Shoal No. 106	69.21		.20	.22	83.72	Sand	3,403
Pool below	69.41	.55					
Shoal No. 107	69.96		.05	.03	83.90	Sand	1,180
Pool below	70.01	.21					
Shoal No. 108	70.22		.12	.08	84.17	Sand	1,917
Pool below	70.34	.18					
Shoal No. 109	70.52		.20	.13	84.40	Sand	2,432
Pool below	70.72	.59					
Shoal No. 110	71.31		.36	.42	85.42	Sand	8,336
Pool below	71.67	.25					
Shoal No. 111	71.92		.68	.72	86.44	Sand	13,033
Pool below	72.60	.16					
Shoal No. 112	72.76		.04	.04	86.67	Sand	4,194
Pool below	72.80	.35					
Shoal No. 113	73.15		.20	.15	87.14	Sand	4,976
Pool below	73.35	.30					
Shoal No. 114	73.65		1.00	.97	88.62		24,841
Pool below	74.65	.20					
Shoal No. 115	74.85		.84	1.27	89.99	Sand	21,974
Pool below	75.69	.25					
Shoal No. 116	75.94		.17	.27	90.41	Sand	3,850
Pool below	76.11	.31					
Shoal No. 117	76.42		.17	.18	90.92	Sand	2,042
Pool below	76.59	.05					
Shoal No. 118	76.64		.39	.39	91.36	Sand	9,380
Pool below	77.03	.55					
Shoal No. 119	77.58		.22	.31	92.25	Sand	3,583
Pool below	77.80	.08					
Shoal No. 120	77.88		.98	1.62	93.96	Sand	19,071
Mouth	78.86						

Total yardage to be removed from Leaf River, 881,047 cubic yards. Fall per mile in Leaf River from Hattiesburg to mouth, 1.192 feet.

Estimate of yardage to be removed from Pascagoula River to obtain a channel 100 feet wide and 4 feet deep, allowing 1 foot for overdepth.

Name of locality.	Distance from initial point of survey.	Length of pool.	Length of shoal.	Fall in each shoal.	Total fall from initial point to foot of shoal.	Character of river bed.	Excavation.
	Miles.	*Miles.*	*Miles.*	*Feet.*	*Feet.*		*Cu. yds.*
Pool below	78.86	0.35					
Shoal No. 121	79.21		0.20	0.06	94.17	Sand	3,901
Pool below	79.41	1.18					
Merrill Bridge	79.50						
Shoal No. 122	80.59		.04	.01	94.34	Sand	244
Pool below	80.63	.41					
Shoal No. 123	81.04		.17	.12	94.69	Sand	2,603
Pool below	81.21	.63					
Shoal No. 124	81.84		.06	.05	95.27	Sand	361
Pool below	81.90	.36					
Shoal No. 125	82.26		.12	.07	95.63	Sand	5,482
Pool below	82.38	3.49					
Shoal No. 126	85.87		.03	.03	97.48	Sand	2,451
Pool below	85.90	.84					
Shoal No. 127	86.74		.07	.02	97.91	Sand	2,081
Pool below	86.81	1.67					
Shoal No. 128	88.48		.14	.06	99.16	Sand	3,157
Pool below	88.62	.48					
Shoal No. 129	89.10		.14	.15	99.63	Sand	3,231
Pool below	89.24	.35					
Shoal No. 130	89.59		.18	.06	100.00	Sand	5,002
Pool below	89.77	.25					
Shoal No. 131	90.02		.12	.08	100.31	Sand	914
Pool below	90.14	.07					
Shoal No. 132	90.21		.24	.29	100.65	Sand	8,727
Pool below	90.45	.30					
Shoal No. 133	90.75		.18	.09	101.08	Sand	1,302
Pool below	90.93	.04					
Shoal No. 134	90.97		.44	.15	101.25	Sand	7,510
Pool below	91.41	.12					
Shoal No. 135	91.53		.39	.26	101.54	Sand	3,823
Pool below	91.92	.95					
Shoal No. 136	93.87		.27	.27	103.11	Sand	1,510
Pool below	94.14	.17					
Shoal No. 137	94.31		.04	.03	103.28	Sand	267
Pool below	94.35	.17					
Shoal No. 138	94.52		.03	.02	103.41	Sand	875
Pool below	94.55	.49					
Shoal No. 139	95.04		.05	.04	103.72	Sand	972
Pool below	95.09	.11					
Shoal No. 140	95.20		.23	.09	103.89	Sand	1,674
Pool below	95.43	.27					
Shoal No. 141	95.70		.20	.05	104.54	Sand	5,592
Pool below	95.90	.37					
Shoal No. 142	96.27		.04	.04	104.91	Sand	959
Pool below	96.31	.30					
Shoal No. 143	96.61		.25	.15	105.23	Sand	3,501
Pool below	96.86	.89					
Shoal No. 144	97.75		.08	.01	105.30	Sand	1,068
Pool below	97.83	.44					
Shoal No. 145	98.27		.13	.02	105.33	Sand	1,222
Pool below	98.40	.30					
Shoal No. 146	98.70		.14	.13	105.80	Sand	8,167
Pool below	98.84	1.36					
Shoal No. 147	100.20		.12	.12	107.00	Sand	2,148
Pool below	100.32	.15					
Shoal No. 148	100.47		.41	.53	107.67	Sand	14,739
Pool below	100.88	1.95					
Shoal No. 149	102.83		.47	.53	108.99	Sand	12,787
Pool below	103.30	.18					
Shoal No. 150	103.48		.21	.16	109.30	Sand	2,291
Pool below	103.69	.09					
Shoal No. 151	103.78		.05	.06	109.61	Sand	702
Pool below	103.83	1.79					
Shoal No. 152	105.62		.02	.01	110.02	Sand	343
Pool below	105.64	.56					
Shoal No. 153	106.20		.32	.32	110.57	Sand	2,939
Pool below	106.52	.21					
Shoal No. 154	106.73		.05	.04	111.00	Sand and mud.	1,161
Pool below	106.78	.79					
Shoal No. 155	107.57		.09	.04	111.41	Sand	3,059
Pool below	107.66	.88					

Estimate of yardage to be removed from Pascagoula River to obtain a channel 100 feet wide and 4 feet deep, allowing 1 foot for overdepth—Continued.

Name of locality.	Distance from initial point of survey.	Length of pool.	Length of shoal.	Fall in each shoal.	Total fall from initial point to foot of shoal.	Character of river bed.	Excavation.
	Miles.	*Miles.*	*Miles.*	*Feet.*	*Feet.*		*Cu. yds.*
Shoal No. 156	108.54		0.17	0.20	112.21	Sand	2,955
Pool below	108.71	0.37					
Shoal No. 157	109.08		.14	.16	112.54	Sand	4,489
Pool below	109.22	.36					
Shoal No. 158	109.58		.27	.20	112.89	Sand	7,111
Pool below	109.85	.48					
Shoal No. 159	110.33		.02	.01	113.15	Sand	169
Pool below	110.35	.96					
Shoal No. 160	111.31		.09	.06	113.68	Sand	2,901
Pool below	111.40	.84					
Shoal No. 161	112.24		.14	.07	114.17	Sand and mud.	3,935
Pool below	112.38	.76					
Shoal No. 162	113.14		.13	.10	114.59	Sand	3,295
Pool below	113.27	1.01					
Shoal No. 163	114.28		.07	.01	115.04	Sand	386
Pool below	114.35	.46					
Shoal No. 164	114.81		.42	.60	115.71	Sand and mud.	9,227
Pool below	115.23	.23					
Shoal No. 165	115.46		.06	.05	115.97	Sand	355
Pool below	115.52	.71					
Shoal No. 166	116.23		.15	.04	116.36	Sand	3,722
Pool below	116.38	1.51					
Shoal No. 167	117.89		.26	.24	117.28	Sand	3,656
Pool below	118.15	.21					
Shoal No. 168	118.36		.02	.01	117.47	Sand	622
Pool below	118.38	.83					
Shoal No. 169	119.21		.26	.14	117.96	Sand	1,967
Pool below	119.47	.34					
Shoal No. 170	119.81		.11	.01	118.13	Sand	1,181
Pool below	119.92	.50					
Shoal No. 171	120.42		.21	.05	118.25	Sand	3,112
Pool below	120.63	.32					
Shoal No. 172	120.95		.23	.24	118.82	Sand	3,225
Pool below	121.18	.25					
Shoal No. 173	121.43		.21	.28	119.11	Sand	5,342
Pool below	121.64	.93					
Shoal No. 174	122.57		.27	.36	119.93	Sand	9,328
Pool below	122.84	.18					
Shoal No. 175	123.02		.05	.01	120.05	Sand	1,126
Pool below	123.07	.88					
Shoal No. 176	123.95		.43	.60	121.09	Sand	11,667
Pool below	124.38	.06					
Shoal No. 177	124.44		.04	.03	121.21	Sand	1,852
Pool below	124.48	.04					
Shoal No. 178	124.52		.06	.05	121.30	Sand	630
Pool below	124.58	.48					
Shoal No. 179	125.06		.29	.21	121.75	Sand and mud.	5,719
Pool below	125.35	2.20					
Shoal No. 180	127.55		.06	.03	122.70	Sand	1,409
Pool below	127.61	.73					
Shoal No. 181	128.34		.08	.02	123.03	Sand	806
Pool below	128.42	32.54					
Mouth of Dog River	160.96				125.03		

Total amount to be excavated from Pascagoula River, 206,953 cubic yards.
Total amount to be excavated from Leaf and Pascagoula Rivers, 1,088,000 cubic yards.

Estimate of yardage to be removed to give a 6-foot channel at mean low water, allowing 1 foot overdepth, channel 75 feet wide.

Name of locality.	Distance from initial point of survey.	Length of pool.	Length of shoal.	Fall in each shoal.	Total fall from initial point to foot of shoal.	Character of river bed.	Excavation.
	Miles.	*Miles.*	*Miles.*	*Feet.*	*Feet.*		*Cu. yds.*
owie Creek Bridge	0.00						
Pool below	.00	0.14					
hoal No. 1	.14		0.10	0.03	0.06	Sand	5,644
Pool below	.24	.55					
hoal No. 2	.79		.53	.37	.62	Sand	15,733
Pool below	1.32	.19					
hoal No. 3	1.51		.11	.07	.85	Sand	6,388
Pool below	1.62	.27					
hoal No. 4	1.89		.72	.18	1.24	Sand	19,217
Pool below	2.61	.16					
hoal No. 5	2.77		.41	.67	2.20	Sand	19,358
Pool below	3.18	.04					
hoal No. 6	3.22		.14	.23	2.49	Sand	7,751
Pool below	3.36	.09					
hoal No. 7	3.45		.37	.55	3.19	Sand	18,188
Pool below	3.82	.29					
hoal No. 8	4.11		.39	.53	4.13	Sand	18,238
Pool below	4.50	.09					
hoal No. 9	4.59		.19	.26	4.60	Sand	7,842
Pool below	4.78	.07					
hoal No. 10	4.85		.55	.12	4.73	Sand	25,738
Pool below	5.40	.14					
hoal No. 11	5.54		1.01	2.19	7.04	Sand	36,873
Pool below	6.55	.14					
hoal No. 12	6.69		.84	1.46	8.79	Sand	37,187
Pool below	7.53	.13					
hoal No. 13	7.66		1.44	1.93	11.32	Sand	60,207
Pool below	9.10	.06					
hoal No. 14	9.16		.76	1.88	13.25	Sand	39,690
Pool below	9.92	.20					
hoal No. 15	10.12		1.56	2.48	16.09	Sand	69,725
Pool below	11.68	.15					
hoal No. 16	11.83		3.35	5.85	22.13	Clay and mud.	108,985
Pool below	15.18	.12					
hoal No. 17	15.30		.84	1.62	23.93	Sand	25,540
Pool below	16.14	.04					
hoal No. 18	16.18		.90	1.61	25.65	Sand	31,804
Pool below	17.08	.32					
hoal No. 19	17.40		6.84	11.34	37.31	Sand	277,209
Pool below	24.24	.09					
hoal No. 20	24.33		.35	.53	37.99	Clay and mud.	9,595
Pool below	24.68	.19					
hoal No. 21	24.87		1.40	1.76	40.16	Clay	73,074
Pool below	26.27	.11					
hoal No. 22	26.38		3.43	7.48	47.85	Mud	133,251
Pool below	29.81	.11					
hoal No. 23	29.92		.81	1.71	49.81	Mud	29,861
Pool below	30.73	.09					
hoal No. 24	30.82		1.23	.65	50.84	Mud and clay.	32,780
Pool below	32.05	.10					
hoal No. 25	32.15		.24	.13	51.02	Mud	6,528
Pool below	32.39	.29					
hoal No. 26	32.68		.22	.22	51.29	Mud	6,128
Pool below	32.90	.26					
hoal No. 27	33.16		.27	.24	51.67	Mud	10,501
Pool below	33.43	.12					
hoal No. 28	33.55		1.26	1.88	53.69	Mud	62,619
Pool below	34.81	.13					
hoal No. 29	34.94		.70	.61	54.47	Clay	23,301
Pool below	35.64	.16					
hoal No. 30	35.80		.68	.71	55.27	Mud	21,123
Pool below	36.48	.04					
hoal No. 31	36.52		1.86	2.62	57.91	Mud	44,994
Pool below	38.38	.43					
hoal No. 32	38.81		.90	1.46	59.67	Mud	31,171
Pool below	39.71	.14					
hoal No. 33	39.85		.56	.12	60.06	Clay	16,970
Pool below	40.41	.27					
hoal No. 34	40.68		.13		60.08	Sand	6,443
Pool below	40.81	.39					

Estimate of yardage to be removed to give a 6-foot channel at mean low water, allowing 1 foot overdepth, channel 75 feet wide—Continued.

Name of locality.	Distance from initial point of survey.	Length of pool.	Length of shoal.	Fall in each shoal.	Total fall from initial point to foot of shoal.	Character of river bed.	Excavation.
	Miles.	*Miles.*	*Miles.*	*Feet.*	*Feet.*		*Cu. yds.*
Shoal No. 35	41.20		0.21		60.08	Sand	9,81
Pool below	41.41	0.15					
Shoal No. 36	41.56		.65	0.27	60.35	Sand	23,78
Pool below	42.21	.17					
Shoal No. 37	42.38		.81	1.08	61.67	Mud	33,87
Pool below	43.19	.04					
Shoal No. 38	43.23		.99	1.46	63.17	Sand	38,04
Pool below	44.22	.55					
Shoal No. 39	44.77		.15	.03	63.34	Sand	7,73
Pool below	44.92	.24					
Shoal No. 40	45.16		.24	.27	63.71	Sand	9,21
Pool below	45.40	1.85					
Shoal No. 41	47.25		.25	.02	64.42	Sand	12,40
Pool below	47.50	.56					
Shoal No. 42	48.06		.39	.02	64.46	Clay and sand.	17,53
Pool below	48.45	.94					
Shoal No. 43	49.34		1.87	1.84	66.59	Clay and sand.	60,10
Pool below	51.21	.24					
Shoal No. 44	51.45		.35	.33	67.27	Clay	9,92
Pool below	51.80	.09					
Shoal No. 45	51.89		.22	.61	68.06	Sand	6,17
Pool below	52.11	.27					
Shoal No. 46	52.38		.71	.62	69.22	Sand	18,85
Pool below	53.09	.68					
Shoal No. 47	53.77		1.42	1.74	71.88	Sand	53,17
Pool below	55.19	.04					
Shoal No. 48	55.23		.78	.94	72.73	Sand	28,93
Pool below	56.01	.06					
Shoal No. 49	56.07		.13	.11	73.04	Sand	4,72
Pool below	56.20	.28					
Shoal No. 50	56.48		.51	.76	73.97	Sand	27,39
Pool below	56.99	.04					
Shoal No. 51	57.03		.85	1.26	75.21	Mud	33,02
Pool below	57.88	1.46					
Shoal No. 52	59.34		.27	.08	75.99	Sand	8,63
Pool below	59.61	.46					
Shoal No. 53	60.07		.04	.05	76.26	Sand	2,29
Pool below	60.11	.43					
Shoal No. 54	60.54		.52	.35	76.88	Sand	20,87
Pool below	61.06	1.42					
Shoal No. 55	62.48		.56	.09	77.36	Sand	27,70
Pool below	63.04	.59					
Shoal No. 56	63.63		.17	.26	78.19	Sand	7,69
Pool below	63.80	.10					
Shoal No. 57	63.90		.21	.22	78.52	Sand	5,87
Pool below	64.11	.18					
Shoal No. 58	64.29		.91	1.19	79.83	Sand	39,21
Pool below	65.20	.13					
Shoal No. 59	65.33		.52	.97	81.25	Sand and mud.	13,66
Pool below	65.85	.07					
Shoal No. 60	65.92		.15	.23	81.57	Sand	12,03
Pool below	66.07	.12					
Shoal No. 61	66.19		.18	.19	81.91	Sand	6,48
Pool below	66.37	.12					
Shoal No. 62	66.49		.34	.24	82.33	Sand	7,85
Pool below	66.83	.01					
Shoal No. 63	66.84		.50	.02	82.35	Sand	22,87
Pool below	67.34	.17					
Shoal No. 64	67.51		.36	.39	82.78	Mud	12,10
Pool below	67.87	.12					
Shoal No. 65	67.99		.09	.01	82.82	Sand	4,03
Pool below	68.08	.25					
Shoal No. 66	68.33		.58	.60	83.45	Sand	18,71
Pool below	68.91	.17					
Shoal No. 67	69.08		.37	.20	83.73	Sand	13,92
Pool below	69.45	.39					
Shoal No. 68	69.84		.91	.79	84.63	Sand	21,06
Pool below	70.75	.15					
Shoal No. 69	70.90		.13	.15	84.73	Sand	6,04
Pool below	71.03	.15					
Shoal No. 70	71.18		1.46	1.60	86.49	Sand	48,941
Pool below	72.64	.10					

stimate of yardage to be removed to give a 6-foot channel at mean low water, allowing 1 foot overdepth, channel 75 feet wide—Continued.

Name of locality.	Distance from initial point of survey.	Length of pool.	Length of shoal.	Fall in each shoal.	Total fall from initial point to foot of shoal.	Character of river bed.	Excavation.
	Miles.	*Miles.*	*Miles.*	*Feet.*	*Feet.*		*Cu. yds.*
ioal No. 71	72.74	.....	0.09	0.08	86.69	Sand.....	8,083
Pool below	72.83	0.22	.....	.....	.....	.....	.....
ioal No. 72	73.05	.....	.40	.32	87.21	Sand.....	13,812
Pool below	73.45	.17	.....	.....	.....	.....	.....
ioal No. 73	73.62	.....	2.54	2.87	90.44	Sand.....	111,295
Pool below	76.16	.16	.....	.....	.....	.....	.....
ioal No. 74	76.32	.....	.89	1.02	91.58	Sand.....	27,597
Pool below	77.21	.23	.....	.....	.....	.....	.....
ioal No. 75	77.44	.....	1.41	2.13	93.97	Sand.....	55,701
outh	78.85	.....	.....	.....	.....	.....	.....

Total yardage to be removed from Leaf River, 2,249,912 cubic yards.

stimate of yardage to be removed from Pascagoula River to obtain a channel 100 feet wide and 6 feet deep, allowing 1 foot for overdepth.

Name of locality.	Distance from initial point of survey.	Length of pool.	Length of shoal.	Fall in each shoal.	Total fall from initial point to foot of shoal.	Character of river bed.	Excavation.
	Miles.	*Miles.*	*Miles.*	*Feet.*	*Feet.*		*Cu. yds.*
ool below	78.87	0.12	.....	.....	.....	.....	.....
ioal No. 76	78.99	.....	0.45	0.16	94.17	Sand.....	14,440
Pool below	79.44	1.11	.....	.....	.....	.....	.....
ioal No. 77	80.55	.....	.29	.13	94.45	Sand.....	3,686
Pool below	80.84	.12	.....	.....	.....	.....	.....
ioal No. 78	80.96	.....	.31	.22	94.74	Sand.....	10,008
Pool below	81.27	.26	.....	.....	.....	.....	.....
ioal No. 79	81.53	.....	.11	.10	95.06	Sand.....	1,288
Pool below	81.64	.14	.....	.....	.....	.....	.....
ioal No. 80	81.78	.....	.25	.36	95.53	Sand.....	3,927
Pool below	82.03	.19	.....	.....	.....	.....	.....
ioal No. 81	82.22	.....	.23	.13	95.66	Sand.....	14,324
Pool below	82.45	.93	.....	.....	.....	.....	.....
ioal No. 82	83.38	.....	.10	.00	95.74	Sand.....	2,963
Pool below	83.48	.53	.....	.....	.....	.....	.....
ioal No. 83	84.01	.....	.16	.17	95.93	Sand.....	1,244
Pool below	84.17	.12	.....	.....	.....	.....	.....
ioal No. 84	84.29	.....	.09	.06	96.08	Sand.....	520
Pool below	84.38	.40	.....	.....	.....	.....	.....
ioal No. 85	84.78	.....	.11	.13	96.53	Sand.....	630
Pool below	84.89	.02	.....	.....	.....	.....	.....
ioal No. 86	84.91	.....	.39	.43	96.98	Sand.....	4,156
Pool below	85.30	.13	.....	.....	.....	.....	.....
ioal No. 87	85.43	.....	.18	.17	97.15	Sand.....	4,144
Pool below	85.61	.12	.....	.....	.....	.....	.....
ioal No. 88	85.73	.....	.25	.29	97.56	Sand.....	1,947
Pool below	85.98	.02	.....	.....	.....	.....	.....
ioal No. 89	86.00	.....	.29	.12	97.69	Sand.....	3,611
Pool below	86.29	.38	.....	.....	.....	.....	.....
ioal No. 90	86.67	.....	.19	.08	97.92	Sand.....	5,383
Pool below	86.86	.15	.....	.....	.....	.....	.....
ioal No. 91	87.01	.....	.06	.05	98.04	Sand.....	600
Pool below	87.07	.45	.....	.....	.....	.....	.....
ioal No. 92	87.52	.....	.24	.20	98.63	Sand.....	1,841
Pool below	87.76	.52	.....	.....	.....	.....	.....
ioal No. 93	88.28	.....	1.14	.07	99.06	Sand.....	35,363
Pool below	89.42	.12	.....	.....	.....	.....	.....
ioal No. 94	89.54	.....	.95	.78	100.72	Sand.....	37,971
Pool below	90.49	.24	.....	.....	.....	.....	.....
ioal No. 95	90.73	.....	1.24	.63	101.61	Sand.....	40,765
Pool below	91.97	.35	.....	.....	.....	.....	.....
ioal No. 96	92.32	.....	.45	.10	101.96	Sand.....	7,411
Pool below	92.77	.27	.....	.....	.....	.....	.....

Estimate of yardage to be removed from Pascagoula River to obtain a channel 100 feet wi and 6 feet deep, allowing 1 foot for overdepth—Continued.

Name of locality.	Distance from initial point of survey.	Length of pool.	Length of shoal.	Fall in each shoal.	Total fall from initial point to foot of shoal.	Character of river bed.	Excava tion.
	Miles.	*Miles.*	*Miles.*	*Feet.*	*Feet.*		*Cu. yds*
Shoal No. 97	93.04		0.50	0.19	102.37	Sand	9,91
Pool below	93.54	0.04					
Shoal No. 98	93.58		.62	.74	103.16	Sand	12,17
Pool below	94.20	.08					
Shoal No. 99	94.28		.14	.04	103.37	Sand	4,27
Pool below	94.42	.06					
Shoal No. 100	94.48		.29	.23	103.55	Sand	2,55
Pool below	94.77	.11					
Shoal No. 101	94.88		1.08	.88	104.50	Sand	29,46
Pool below	95.96	.12					
Shoal No. 102	96.08		.28	.26	104.94	Sand	5,96
Pool below	96.36	.06					
Shoal No. 103	96.42		.47	.24	105.24	Sand	14,03
Pool below	96.89	.06					
Shoal No. 104	96.95		.12	.01	105.27	Sand	1,12
Pool below	97.07	.55					
Shoal No. 105	97.62		.24	.01	105.30	Sand	5,87
Pool below	97.86	.38					
Shoal No. 106	98.24		.73	.59	105.91	Sand	29,10
Pool below	98.97	.43					
Shoal No. 107	99.40		.33	.15	106.40	Sand	2,82
Pool below	99.73	.40					
Shoal No. 108	100.13		.91	1.03	107.90	Sand	48,13
Pool below	101.04	.08					
Shoal No. 109	101.12		.25	.12	108.09	Sand	4,66
Pool below	101.37	.35					
Shoal No. 110	101.72		.25	.07	108.20	Sand	4,30
Pool below	101.97	.82					
Shoal No. 111	102.79		.53	.54	109.00	Sand	35,18
Pool below	103.32	.10					
Shoal No. 112	103.42		.30	.25	109.34	Sand	10,50
Pool below	103.72	.01					
Shoal No. 113	103.73		.13	.17	109.52	Sand	3,11
Pool below	103.86	.09					
Shoal No. 114	103.95		.36	.09	109.69	Sand	3,75
Pool below	104.31	.82					
Shoal No. 115	105.13		.10	.02	109.82	Sand	2,07
Pool below	105.23	.30					
Shoal No. 116	105.53		.20	.09	110.05	Sand	5.34
Pool below	105.73	.29					
Shoal No. 117	106.02		.85	.62	111.01	Sand	24,44
Pool below	106.87	.50					
Shoal No. 118	107.37		.43	.19	111.47	Sand	10,34
Pool below	107.80	.40					
Shoal No. 119	108.20		.55	.59	112.25	Sand	20,25
Pool below	108.75	.27					
Shoal No. 120	109.02		.42	.33	112.64	Sand	13,34
Pool below	109.44	.42					
Shoal No. 121	109.86		.16	.12	113.03	Sand	17,99
Pool below	110.02	.09					
Shoal No. 122	110.11		.08	.03	113.11	Sand	1,36
Pool below	110.19	.10					
Shoal No. 123	110.29		.18	.07	113.20	Sand	3,45
Pool below	110.47	.68					
Shoal No. 124	111.15		.27	.16	113.69	Sand	9,70
Pool below	111.42	.94					
Shoal No. 125	112.36		.07	.04	114.19	Sand and mud.	11,57
Pool below	112.43	.29					
Shoal No. 126	112.72		.12	.05	114.36	Sand	1,53
Pool below	112.84	.24					
Shoal No. 127	113.08		.22	.15	114.61	Sand	8,04
Pool below	113.30	.62					
Shoal No. 128	113.92		.48	.25	115.04	Sand	10,601
Pool below	114.40	.23					
Shoal No. 129	114.63		.62	.62	115.72	Sand and mud.	26,47
Pool below	115.25	.19					
Shoal No. 130	115.44		.09	.09	115.98	Sand and mud.	2,065
Pool below	115.53	.38					
Shoal No. 131	115.91		.08	.06	116.21	Sand and mud.	1,94
Pool below	115.99	.05					

Estimate of yardage to be removed from Pascagoula River to obtain a channel 100 feet wide and 6 feet deep, allowing 1 foot for overdepth—Continued.

Name of locality.	Distance from initial point of survey.	Length of pool.	Length of shoal.	Fall in each shoal.	Total fall from initial point to foot of shoal.	Character of river bed.	Excavation.
	Miles.	*Miles.*	*Miles.*	*Feet.*	*Feet.*		*Cu. yds.*
Shoal No. 132	116.04	.....	0.57	0.45	116.70	Sand	20,732
Pool below	116.61	1.21	.....	.....	.....	.....	.....
Shoal No. 133	117.82	.....	.36	.32	117.32	Sand	13,857
Pool below	118.18	.14	.....	.....	.....	.....	.....
Shoal No. 134	118.32	.....	.36	.12	117.58	Sand	5,200
Pool below	118.68	.34	.....	.....	.....	.....	.....
Shoal No. 135	119.02	.....	.47	.32	117.97	Sand	9,479
Pool below	119.49	.18	.....	.....	.....	.....	.....
Shoal No. 136	119.67	.....	.26	.04	118.13	Sand	6,958
Pool below	119.93	.28	.....	.....	.....	.....	.....
Shoal No. 137	120.21	.....	.49	.12	118.28	Sand	14,751
Pool below	120.70	.22	.....	.....	.....	.....	.....
Shoal No. 138	120.92	.....	.28	.06	118.56	Sand	10,696
Pool below	121.20	.24	.....	.....	.....	.....	.....
Shoal No. 139	121.44	.....	.28	.28	119.26	Sand	16,350
Pool below	121.72	.16	.....	.....	.....	.....	.....
Shoal No. 140	121.88	.....	.12	.03	119.37	Sand	1,135
Pool below	122.00	.53	.....	.....	.....	.....	.....
Shoal No. 141	122.53	.....	.90	.61	120.15	Sand	31,765
Pool below	123.43	.32	.....	.....	.....	.....	.....
Shoal No. 142	123.75	.....	.89	1.07	121.32	Sand	43,361
Pool below	124.64	.24	.....	.....	.....	.....	.....
Shoal No. 143	124.88	.....	.48	.35	121.76	Sand and mud.	17,571
Pool below	125.36	.46	.....	.....	.....	.....	.....
Shoal No. 144	125.82	.....	.30	.16	122.26	Sand	3,400
Pool below	126.12	.78	.....	.....	.....	.....	.....
Shoal No. 145	126.90	.....	.79	.34	122.90	Sand	17,967
Pool below	127.69	.13	.....	.....	.....	.....	.....
Shoal No. 146	127.82	.....	.16	.10	122.93	Sand	1,166
Pool below	127.98	.12	.....	.....	.....	.....	.....
Shoal No. 147	128.10	.....	.50	.08	123.04	Sand	1,852
Pool below	128.60	.07	.....	.....	.....	.....	.....
Shoal No. 148	128.67	.....	.10	.06	123.10	Sand	272
Pool below	128.77	.21	.....	.....	.....	.....	.....
Shoal No. 149	128.98	.....	.06	.12	123.30	Sand	845
Pool below	129.04	31.92	.....	.....	.....	.....	.....
South	160.96	.....	.....	.....	.....	.....	.....

Total to be excavated from Pascagoula River 810,088 cubic yards.
Total to be excavated from Leaf and Pascagoula Rivers 3,060,000 cubic yards.

IMPROVEMENT.

For obtaining and maintaining a channel from Dead Lake to mouth of river, 100 feet wide and 10 feet deep at mean low tide, only cost of removing snags.

This lower section of the Pascagoula, has lately been snagged.

The floods usually occur in these rivers in the spring and early summer, and the lowest water in the fall. At Merrill where the United States has kept gauge observations for about seven years on the Pascagoula, the flood of 1900 reached 28 and that of 1909, 25 feet 6 inches at same point. Merrill is at the New Orleans, Mobile & Chicago Railroad crossing of the Pascagoula. The lowest observation recorded gave 0.2 on the gauge which is 0.8 below ordinary low water. This extreme low water occurs about once in six years and only for a few weeks at a time. In the lower portion of the Pascagoula the floods attain a much less height, but no reliable high-water marks were found. Discharge measurements were taken at Hattiesburg and one-half mile above the mouth of the Leaf. Also of the Chickasahay River near its mouth and of the Pascagoula, at Merrill, and 2 miles above Dead Lake where tidal influence first appeared. The following are the results of these measurements which were taken on different dates and at different stages of water.

LEAF RIVER.

Locality.	Date.	Gauge.	Discharge.
			Sec.-ft.
Hattiesburg, Miss	July 12, 1910	+ 2.1	2,0
Do	Oct. 27, 1910	0.0	5
Leaf ½ mile above mouth	Oct. 29, 1910	[1]+ 0.2	8
Do	Aug. 29, 1910	[1]+ 2.3	1,7
Do	July 14, 1910	[1]+ 9.0	5,2

CHICKASAHAY RIVER.

One-half mile above mouth	Oct. 29, 1910	+ 0.2	5
Do	Aug. 29, 1910	+ 2.3	1,1
Do	July 14, 1910	+10.5	5,6

PASCAGOULA RIVER.

At Merrill	Aug. 14, 1910	[1]+ 2.3	3,2
Do	Oct. 30, 1910	[1]+ 0.2	1,3
Do	July 13, 1910	+11.0	16,6
2 miles above Dead Lake	Sept. 24, 1910	+ 0.5	1,7

[1] Gauge at Merrill. On the Merrill gauge 0.2 equals extreme low water.

There are at present no boats on Leaf River at any season of the year. They ca not run at low water and the county bridges prevent them from running at highe stages. On the Pascagoula, a small boat has ascended to Merrill 81.3 miles at irregula intervals, but there is no regular trade and none except small launches have bee there this year (1910). Tugs ascend to Dead Lake to bring out rafts of logs and cross ties or telephone poles. Two years ago a small steamer named the *Owl* made trips t Benndale in the employ of the Farnsworth Lumber Co., carrying commissary stores This mode of transportation has been discontinued and the stores are now haule from the railroad 12 miles distant. A small boat has in the past been as far as Hat tiesburg, on the Leaf, before the present bridges were built. The county trustees o Forest and Greene Counties were seen and expressed willingness to alter these bridge if shown to them that the river could be made navigable.

No doubt many of the sand bars now existing in the rivers, especially in the Leaf have been wholly or partially formed by the logs lodging at certain points. Snagging the river thoroughly would therefore constitute a large part of the work of improve ment. This work of snagging is now being done. There are two snagboats, on working from Hattiesburg down, the other from Dead Lake up. They can only worl during the low water season about eight months of each year. At their present rat of progress, which is the best practicable, several years will be required to make on trip over the two rivers. About three-fourths of the obstructions are saw logs whic have been turned adrift, the present custom being to drive or float logs instead o rafting them.

Were all snags removed many of these bars would doubtless scour out. If th custom of floating the logs loose should be abandoned and rafting adopted and require there would be fewer obstructions. At present the rivers appear to be given up t the men owning the timber interests. If the river should be improved commerc would probably be much increased. The mill men at Moss Point have combined an built a log boom of timbers chained to piling which are driven 20 feet apart. Thi boom is 4 miles long near the mouth of the Pascagoula, being located near the cente of the river. There is also a short boom across the West Fork of the Pascagoula, fo the principal purpose of confining floating timber to the East Fork.

The citizens of Hattiesburg would take the lead in using the river and put a boa in if practicable. Interest at other points is less. There are railroad bridges a Hattiesburg, New Augusta, and Merrill. The last named bridge is provided with a draw which has lately been put in good condition. There are county highway bridge at Hattiesburg (two), Belleville, Mahned, New Augusta, Wingate, and McLain.

The timber business has declined somewhat the last two years on account of low prices, more than on account of a scarcity of timber. The Farnsworth Lumber Co., who operate two log railroads reaching the river at Benndale, say they have timber enough to keep them 12 years getting it to the river.

I do not think any land would be reclaimed in improving the river unless the flood lines should be considerably altered, but owners of lands would be encouraged to drain them if assured of permanent navigation. Much of the land has been "cut over" and might be used for farming or stock raising.

The expenses of the survey were as follows:

Establishing preliminary benches		$119.76
Building quarter boat	$935.54	
Survey proper:		
Pay rolls	4,297.65	
Subsistence	1,096.65	
Miscellaneous	90.37	
Total survey		6,420.21
Office work on quarter boat to Dec. 31, 1910:		
Pay rolls	642.01	
Subsistence	86.06	
Miscellaneous	52.86	
Total office work		780.93
Total cost to Dec. 31, 1910		7,320.90

Very respectfully,
Maj. C. A. F. FLAGLER,
Corps of Engineers.

C. A. TURRELL, *Surveyor.*

SUPPLEMENTAL REPORT.

UNITED STATES ENGINEER OFFICE,
Mobile, Ala., February 1, 1915.

SIR: 1. Since the reference of these papers to this office, repeated attempts have been made to secure from the persons interested in the improvement statements of changes in local business conditions which might bear upon the advisability of the improvement. Failing to secure reply to letters on the subject, after due notice to those concerned, I recently visited Hattiesburg, Miss., and had an interview with the secretary of the commercial club and with other prominent citizens, none of whom were able to supply any additional information of sufficient importance for record here. In this connection attention is invited to the accompanying letter[1] from the secretary of the commercial club. In a general way I also had the opportunity to investigate the industries of the city of Hattiesburg, and thereafter I made a personal inspection of the river between Hattiesburg and Merrill, Miss., a distance of approximately 79 miles.

2. At the time of my inspection the river was at a medium stage, not so high, however, as to prevent me from forming a satisfactory idea of its general character. It is plainly a river with movable bed, and the 181 bars mentioned in the report on the survey are composed of relatively light material, the supply of which is large, practically inexhaustible. Any attempt to improve the stream by dredging away the obstructing shoals would be a failure unless provision were made for removing the same shoals or others near by at frequent intervals, and in any event dredging bars would lower pools above them and thus prove of little avail. Of the 1,000,000 yards of dredging shown to be required for the 4-foot channel, a large part would without doubt be required to be removed annually.

[1] Not printed.

3. The slope of the upper portion of the river is too great to give any just basis for the expectation that it can be improved by the kind of regulation described in the report, and if regulation and dredging of more thorough character are resorted to, the cost of the original improvement will certainly not be less than $5,000 a mile, and may perhaps be more. On the Mississippi River above Lake Pepin where the low-water discharge is approximately three times that ascribed to Leaf River, but where the slope is much gentler, the cost of improvement under the original project for a 4-foot channel, approximated $15,000 per mile, and here stone, the more costly of the material used, was very cheap. On Leaf River the cost of stone would be prohibitive, and yet contraction works of reasonable stability can not be built without its use.

4. Between Hattiesburg and Merrill there is not a single town of any kind on the river banks, and Merrill is a very small village. At the three or four localities where houses were to be seen from the river, these were isolated structures. Nowhere was there any evidence of human habitation to an extent worthy of consideration. Where the banks of the river were sufficiently high to permit the cultivation of the soil, the cultivated lands lay a mile or thereabouts from the river bank.

5. All circumstances considered, it is believed that while the country in the vicinity of Leaf and Pascagoula Rivers will eventually be well settled by a prosperous and productive community, at present the conditions are not such as to promise the profitable use of the improvements now asked for by the locality, the only industry at all likely to use the improved stream being rafting, which apparently even now does not use to the fullest extent the facilities available.

6. Pascagoula River below Merrill, which was recently inspected by Assistant Engineer Reed, has low banks, and there is little likelihood that much traffic will originate on it except logs and lumber in rafts. Such traffic as will use the two streams, which practically constitute a continuous whole, will either originate in or be destined for Merrill and points above it.

7. While my recommendation has not been asked, it seems permissible to suggest that the prosecution of the existing project below Merrill only upon a more liberal scale, at any rate for a limited period of years, might considerably improve navigation so as to furnish sufficient facilities until the time when the building up of the tributary territory might justify renewed consideration of the question of further improvement below Merrill and resumption of operations between Merrill and Hattiesburg. Up to June 30, 1914, the total spent upon the entire length of the river under consideration amounted to about $97,000—an average of something less than $4,000 a year. This is certainly too little to produce useful results. To operate a non-propelled steam snagboat with attendant small launch, will cost about $15,000 per year. I regard the local situation as sufficiently promising to justify this expenditure below Merrill for a limited period, and accordingly recommend that the action upon this survey report be such as to cause this amount to be made available annually. When rafting no longer exists to cause accumulations of snags and obstructions to navigation in the Leaf River between Hattiesburg and Merrill in such quantities as to make it almost impossible to dispose of the recurrent supply, it is probable that commercial conditions

will have become such as to justify the expense of improving its channel so as to afford a depth of from 3 to 4 feet at low water.

C. KELLER,
Lieut. Col., Corps of Engineers.

The CHIEF OF ENGINEERS, UNITED STATES ARMY
(Through the Division Engineer).

[Third indorsement.]

OFFICE OF DIVISION ENGINEER, GULF DIVISION,
Baltimore, Md., February 8, 1915.

To the CHIEF OF ENGINEERS.

1. Forwarded.

2. It is not believed that there is any real demand for the improvement of the upper portions of Leaf and Pascagoula Rivers, except from the town of Hattiesburg, which desires the work for the purpose of becoming a town possessing water competition with the railroads and thus securing reduced railroad rates.

3. The banks of both the Leaf and the Pascagoula are almost continuously bordered by woods, with the exception of an occasional small area cleared for a log landing, and a very few old fields. The cultivated fields near the river banks do not number more than a dozen in all. The small towns or villages which do occur along the river and have cleared landings appear to be adjuncts of sawmills.

4. The distance by water is 160 per cent of that by railroad, and more than 200 per cent of direct line distance. The river bottoms are from $\frac{1}{4}$ to 2 miles wide, generally low and frequently consisting of swamp, and are generally passable only in the dry season. Through these bottom lands are frequent small chutes leaving the river and rejoining it some miles below, forming a network of small channels containing water at high stages, but forming obstructions to development of land at all times. These conditions do not appear to have changed in any respect since the first report was submitted.

5. There seems to be no demand for the improvement except from Hattiesburg for the purpose stated above. Under these circumstances the division engineer is of the opinion that the only navigation of the stream is the floating of logs, and believes that no greater or more expensive improvement should be undertaken by the Government than that necessary to facilitate this class of commerce.

LANSING H. BEACH,
Colonel, Corps of Engineers,
Division Engineer.

[Fifth indorsement.]

BOARD OF ENGINEERS FOR RIVERS AND HARBORS,
February 16, 1915.

To the CHIEF OF ENGINEERS, UNITED STATES ARMY.

1. The views of the board were fully expressed in its report dated November 4, 1912, and there is nothing in the supplemental report of the district officer to change them. The papers are therefore returned without modification.

For the board:

W. M. BLACK,
Colonel, Corps of Engineers,
Senior Member of the Board.

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WAR DEPARTMENT

CORPS OF ENGINEERS, U.S. ARMY.